INFORMATION REPORT INFORMATION REPORT

CENTRAL INTELLIGENCE AGENCY

S-E-C-R-E-T

25X1

COUNTRY USSR

REPORT

SUBJECT Description and Technical Specifications for the YAK-20

DATE DISTR. 3 September 1959

NO. PAGES 1

REFERENCES RD

DATE OF INFO.

PLACE & DATE ACQ

Ord #777

25X1

FIELD REPORT NO. 25X1

SOURCE EVALUATIONS ARE DEFINITIVE. APPRAISAL OF CONTENT IS TENTATIVE.

175-page English-language booklet containing descriptions, technical specifications, and operating instructions for the YAK-20 25X1 The YAK-20, also designated the YAK-18A, is a two-seat primary trainer powered by an AI-14R air-cooled engine equipped with a V-530D35 variable pitch propeller. 25X1

25X1

25X1

S-E-C-R-E-T

19-08-47

STATE	X	ARMY	X	NAVY	X	AIR	X	FBI		AEC						

(Note: Washington distribution indicated by "X"; Field distribution by "#".)

INFORMATION REPORT INFORMATION REPORT

25X1

SECRET

[redacted]

DESCRIPTION AND OPERATING

INSTRUCTION FOR THE ЯК-18А(ЯК-20)

AIRCRAFT.

SECRET

[redacted]

25X1

SECRET

DESIGN

25X1

GENERAL.

The ЯК-18A aircraft (Fig.1) is a two-seat primary trainer.

It is a single-engine monoplane with a low cantilever wing and tricycle retractable landing gear.

The monoplane is powered by AM-44P air-cooled engine equipped with a B-530A35 hydraulically controlled variable pitch propeller.

The pilots' cabins are of a standard type and are placed in tandem.

The instruments make the aircraft suitable for day and night flying in good weather conditions.

A VHF radio, automatic direction finder, interphone equipment, retractable L.G. with brake wheels, flaps, compressed-air starter and controllable engine cooling system permit the students to pile up aircraft equipment usage experience during elementary training.

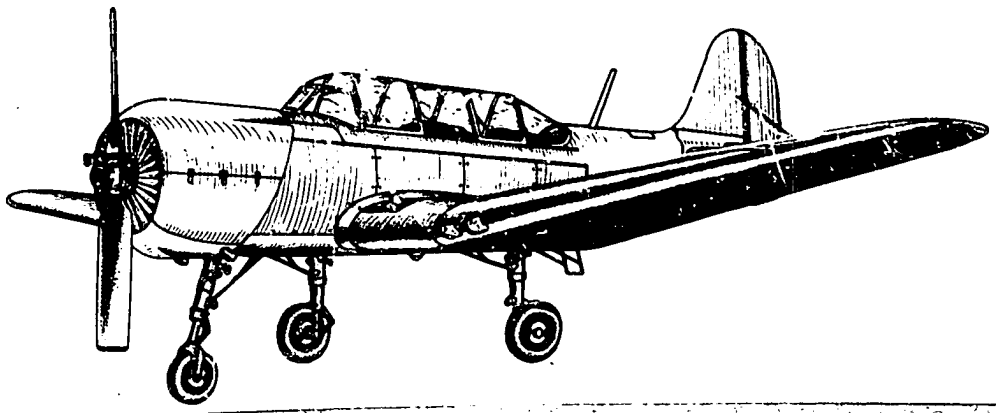


Fig.1 General view.

25X1

SECRET

I. PRINCIPAL CHARACTERISTICS AND PERFORMANCE.

25X1

[redacted]

1. PERFORMANCE.

Max. speed in level flight at sea level - 254 km.h.
(at 2,050 r.p.m.)

Rate of climb at sea level - 5 m.sec. (at 2,050 r.p.m.)

Time to:		
500 m	-	1,7 min.
1,000 m	-	3,6 min
2,000 m	-	8,1 min
3,000 m	-	14 min
4,000 m	-	23 min

Service ceiling	5000 m
Time to service ceiling	40 min
Take-off run	210 m.
Landing run (flaps down, brakes applied)	260 m.
Landing speed	105 km.h.
Min. speed at gliding (engine idling, L.G. and flaps down)	110-115 km.h.
Range in level flight at 500 m. (mixture control cut off)	721 km.
Max. permissible I.A.S.	340 km.h.

NOTE: Take-off and landing performance are given for a grass covered airfield.

2. DIMENSIONS.

WING.

Airfoil	Clark - YH
Area	17 m^2
Span	10,500 mm
M.A.C. length	1,686 mm.

25X1

[redacted]

SECRET

[redacted]

Root chord length	2,000 mm
Dihedral angle at [redacted] line	[redacted] 25X1
Incidence angle	+2° 25X1
Aileron area	1.3 m²
Aileron full deflection:	
up	22°
down	15°
Flap area	1.125 m²
Flap angular motion	50°

STABILIZER.

Stabilizer area	3.185 m²
Elevator area	1.235 m²
Span	3,940 mm
Stabiliser incidence angle (relative to reference line)	0°
Elevator full deflection:	
up	25°
down	20°
Elevator trim-tab area	0.05 m²
Trim-tab full deflection	±2°

VERTICAL TAIL.

Vertical tail area	1.575 m²
Rudder area	0.857 m²
Rudder full deflection:	
to the right	27°
to the left	27°
Aircraft length in level flight position	8,180 mm
Ground angle	3°45'
Track	2,510 mm
Wheelbase	1,845 mm

SECRET

[redacted] 25X1

SECRET

Main wheel tyre size 500x150

Nose wheel tyre size [redacted] 25X1

[redacted]

3. WEIGHTS AND CENTRE GRAVITY POSITION DATA.

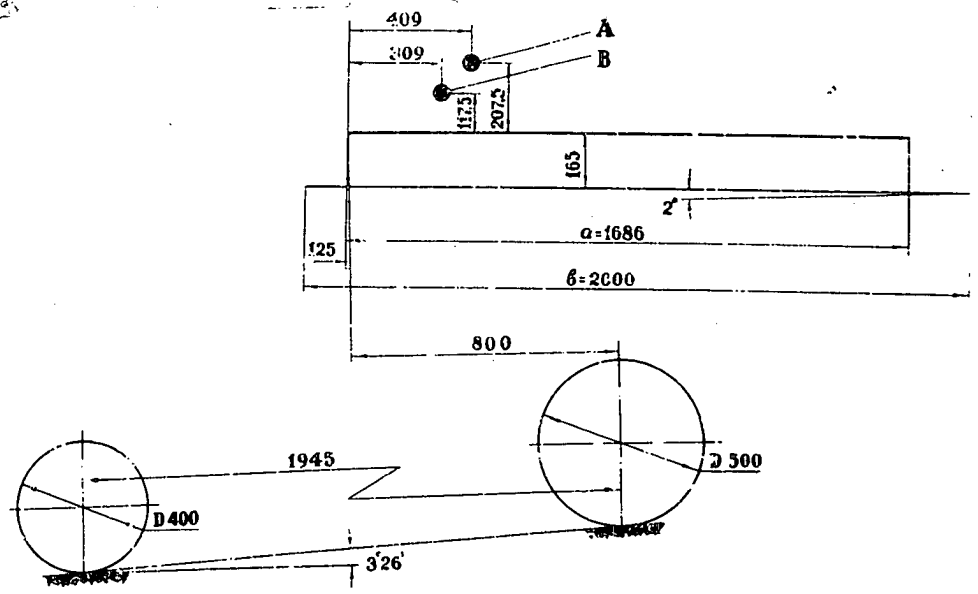
Names of versions	Weight, kg.	Centre gravity position, % M.A.C.
Empty weight	995	18.3
Gross weight	1,281	24.3

NOTE: 1. Total load of the aircraft includes:

a) Crew	180 kg.
b) Fuel	90 kg.
c) Oil	16 kg.

2. The aircraft centre gravity position data are given only with the landing gear extended; the centre gravity position with the landing gear retracted is practically the same.

The centre gravity data diagram is shown in Fig.2.



SECRET

Fig. 2. - C.G. position data diagram.

[redacted] 25X1

SECRET

A - C.G. position at gross weight.
B - C.G. position at empty weight.
- Wing M.A.C.
- Wing centre section ch[illegible]

II. AIRFRAME STRUCTURE.

GENERAL.

The SK 12A all-metal aircraft comprises the following ten sections: fuselage, wing centre - section, two wing outer panels, two ailerons, stabilizer, elevator, fin and rudder. All the sections are joined by bolts.

The aircraft exploded view is shown in Fig.3.

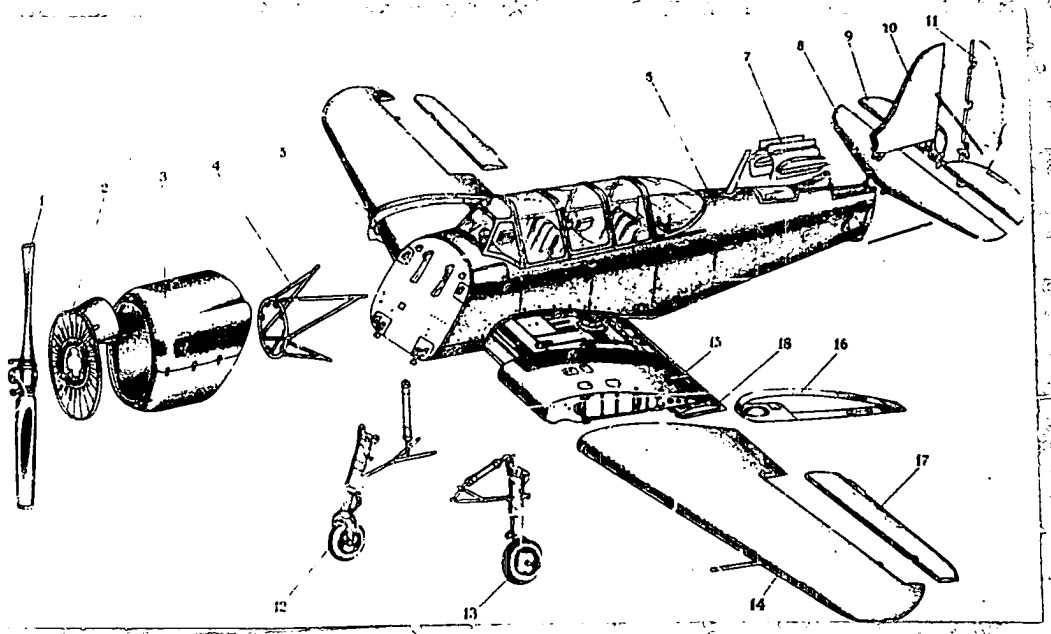


Fig. 3. Aircraft exploded view.
1) Propeller; 2) shutters; 3) engine cowl; 4) engine mount; 5) centre section-to-fuselage fillet; 6) fuselage; 7) tail unit fillet; 8) stabilizer; 9) elevator; 10) fin; 11) rudder; 12) nose gear shock strut with brace strut and jack; 13) main gear shock strut with brace strut and jack.

14) wing outer panel; 15) wing centre section; 16) wing splice strip; 17) aileron; 18) landing flap. 25X1

25X1

1. FUSELAGE.

The ЯК-18А (Fig.4) consists of three rigidly joined components: fuselage framework, canopy and elements forming the fuselage configuration.

The fuselage framework is a truss of rectangular section welded of standard steel tubes (σ_t=70-90 kg/mm^2) and formed by a pair of upper and a pair of lower longerons. The longerons are connected by ten frames (numbered from 0 to 9), by brace struts and a pair of bracing wires on frame 6.

The framework upper longeron consists of joined and welded tubes, 30x27, 27x25, 22x20 and 20x18 dia; the lower longeron consists of tubes 28x25, 25x22, 25x23, 20x18 and 18x16 dia.

Frames and brace struts are made of tubes of the same dia and tubes of 16x14 and 14x12 dia.

In the lower part of frame "0" is a tubular truss to which the nose gear attachment fittings are welded.

The nose gear jack attachment fitting is welded to the upper tube of the frame. The engine mount attachment fittings are welded in places where the fuselage longerons and the tubes of frame "0" join.

The lower tube of frame 1 is reinforced by additional brace struts, also forming a truss. To this tube are welded: the knuckle brace strut attachment fittings, brackets for the nose gear "up" lock and brackets for the front cabin control attachment.

Four wing centre section attachment fittings are located on the sides of the fuselage framework (two -on each side) in places where the axes of the lower spars cross the tubes of frames 2 and 3.

Three fittings for the stabilizer attachment are welded to the upper longerons at frame 6 and to the tube at frame 9; the fin attachment fittings are welded to the former at

25X1

frame 8 and to frame 9.

To secure the stabilizer to the fuselage the brace and bracing wires attachment fittings are welded to 25X1 the lower longerons at frames 8 and 9.

The elevator control bell crank attachment bracket is welded to frame 4 from underneath; brackets of the guide pulleys for the pedal control cables are welded to the lower intercostal of frame 8.

Besides, to the fuselage framework are welded: brackets for attaching the fire wall with the equipment installed on it; instrument panels and control boards attachment brackets; the canopy and seats attachment fittings; brackets for attaching the elements forming the fuselage configuration, some units of the equipment and engine control rods; pins for connecting negative wires of power consumers and supply sources.

The fuselage framework and the inner sides of the longerons are covered with AMT -5 prime coating; in the region of the cabins the fuselage framework is coated with A-23M enamely

The main element of the canopy is a duralumin framework covered with duralumin skin in its lower part.

The upper part of the canopy consists of a windshield, fixed centre section, rear fairing and two sliding sections covered with organic glass 3 or 4 mm thick.

The sliding sections of the canopy fitted with ball-bearings can be moved backward on the guide rails and locked in three positions by latches located on the left.

The front part of the windshield has a shutter for ventilation of the front pilots' cabin; ventulation of the rear cabin is provided by an extending air scoop, installed on the canopy starboard side. Access doors hinged to the either side of the canopy front part afford good access to the instruments of the board. A duralumin panel for the A.D.F. receiver is installed on the upper panel of the fuselage framework between frames 4 and 5.

The canopy is attached by seven bolts to the fuselage longerons.

25X1

25X1

25X1

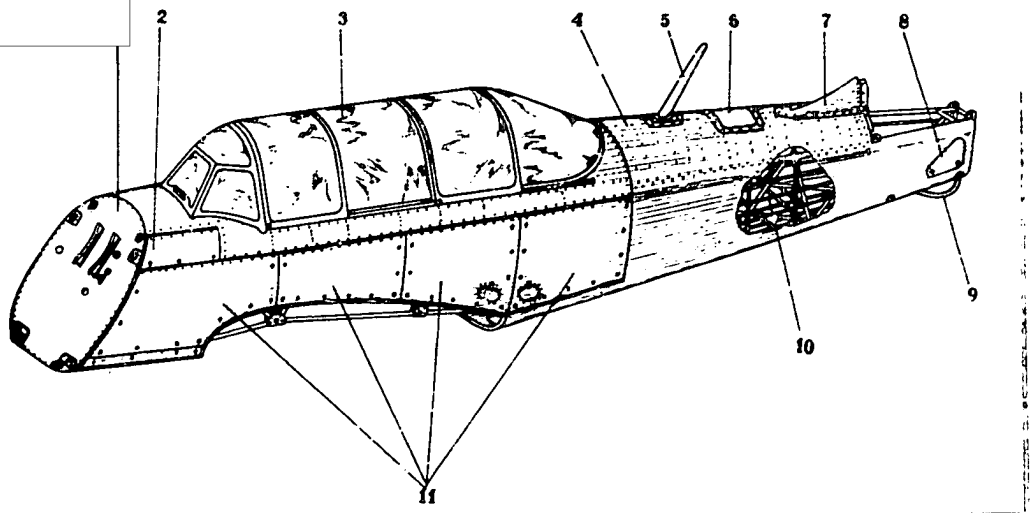


Fig. 4. Fuselage.
1) Fire-wall; 2) front opening panel; 3) canopy; 4)upper turtleback; 5) must antenna; 6) removable glass panel of automatic direction finder loop antenna1 7) fin fairing; 8) rear access door; 9) emergency bumper skid; 10) side panel; 11) side opening panels.

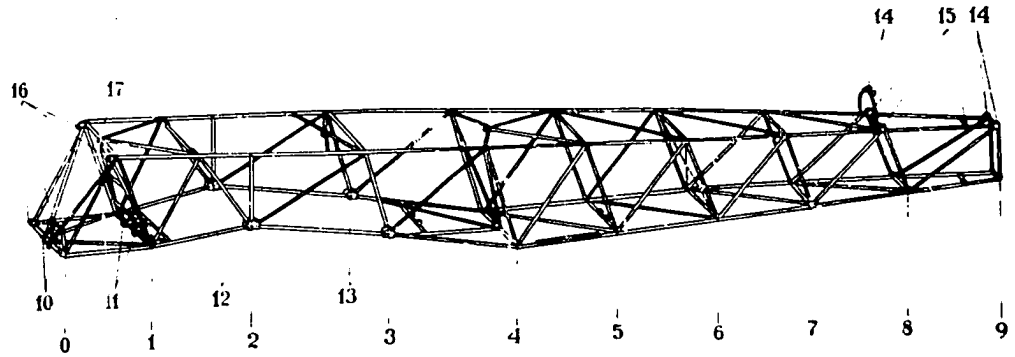


Fig. 5 Fuselage framework.
0-9) Fuselage frames; 10) nose gear attachment fittings; 11)nose gear brace strut attachment fittings;12 and 13 fuselage-to-wing centre section attachment fittings;14)fuselage -to-fin attachment fittings; 15) fuselage-to-stabilizer

25X1

attachment fittings; 16) fuselage-to-engine mount attachment fittings; 17) nose gear jack attachment fitting.

Elements forming the fuselage configuration comprises: side opening panels, firewall, bay for the nose gear wheel, the fuselage upper and lower turtlebacks and side panels of the tail fuselage.

The side opening panels (three - on the starboard side and four - on the port side) are hinged to the fuselage and fixed with spring locks; the access doors are retained in the open position by tubular knuckle struts.

A duralumin fire-wall reinforced around its perimeter is installed in the plane of frame "0" and is riveted to the welded brackets of the frame.

The nose gear well is riveted of duralumin sheets and sections and is located beneath the front cabin floor. The front part of the well is attached to the fire wall, its rear part - to the lower flange of the wing centre section front spar.

Elements forming the fuselage configuration comprises: the upper and lower turtlebacks and fuselage side panels assembled together. They are bolted to the fuselage framework through the pipes, welded to the brace struts at the lower longerons and riveted to the brackets welded, to the upper longerons.

The turtlebacks and side panels consist of frames and V - stringers, riveted together.

The side panels and lower turtleback have fabric covering, which is coated with varnish and enamel. The upper turtleback is covered with duralumin skin.

The common stub antenna for the radio set and automatic direction finder and the automatic direction finder loop antenna are installed on the upper turtleback; the dorsal fin fading out into the fin L.E. is installed in the rear part of the turtleback.

The panel with the radio equipment is attached to the welded brackets of the fuselage framework, between frames 4 and 5.

The tail emergency bumper skid made of 30x28 dia. tube is attached to frame 9 and to the tube welded to the fuse- lower longerons, between frames 8 and 9. The tail emergency bumper skid serves for protecting the tail fuselage from damages and for mooring the aircraft. The tail and centre sections of the fuselage are separated by a fabric partition, which is placed in the plane of frame 8.

Besides the side opening panels and front opening doors, there are some other access doors in the fuselage. The location and purpose of the access doors are shown in Fig. 27.

2. WING.

The ЯК-18А has a two-spar wing with interspar bracing wires. It consists of a rectangular centre section and trapezoidal-shaped removalbe outer winges. The wing centre section and outer panel are joined between ribs 4 and 5 at four points: two on the front and two on the rear spars. The slot on the wing break line is covered with a quick removable duralumin strip.

WING CENTRE SECTION.

The wing centre section framework comprises two spars, eight ribs, stiffeners, mounted on the upper skin between ribs 2 and 4, and two stringers, front and rear (Fig.6).

The front stringer is a riveted beam of I - section; it consists of a reinforced duralumin web and two caps, made of Пр 100-15 pressed sections (two - on the upper and two - on the lower cap). The spar upper cap, between ribs 2 - 2, is reinforced with Пр110-2 duralumin sections riveted to it.

At the centre line the spar web is provided with a cut-out for the stick control shaft; in the region of the cut-out the web is reinforced with a duralumin plate and two vertical sections. Right of the aircraft centre line

[redacted] 25X1

[redacted] as a cut-out for the oilcooler outlet duct; the [redacted] reinforced with plates and sections. Steel fittings for the outer wing attachment are mounted on the spar. Each fitting consists of a flat plate, 2-mm. thick and flat lugs, 4 and 6-mm thick. The plate and lugs are bolted to the spar cap and riveted to the spar web. Milled steel fittings for the main gear knuckle brace struts attachment are mounted on the lower cap of the front spar. The wing centre section -to-fuselage attachment fittings made of steel are bolted to the upper cap. 25X1

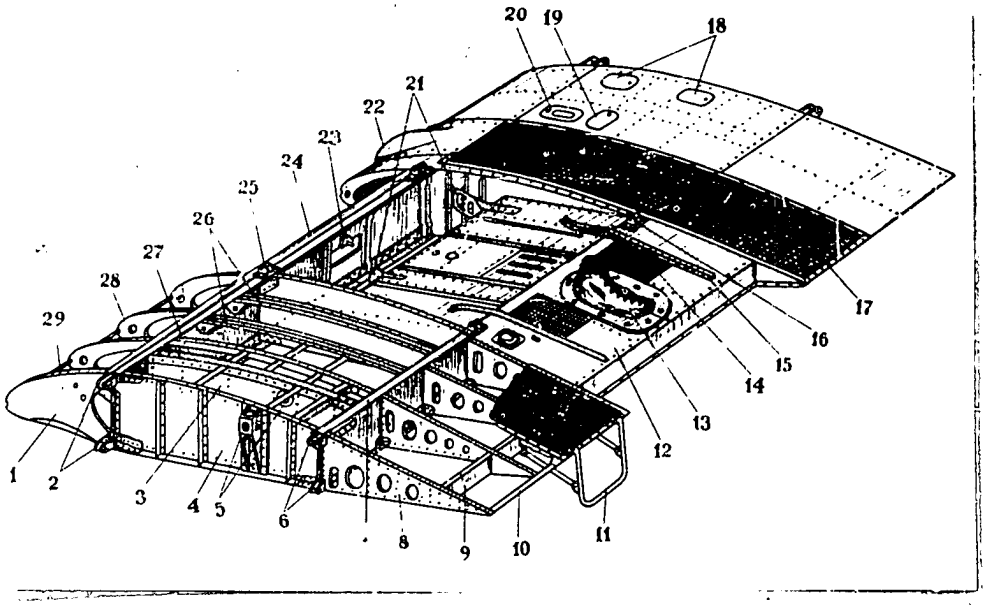


Fig. 6. Wing centre section.

1) Nose rib 4; 2 and 6) wing centre section -to-outer wing attachment fittings; 3) rib 3; 4) rib 4; 5) main L.G. strut attachment fittings; 7) rear spar; 8) rear rib 4; 9)false spar; 10) rear stringer; 11) entry step; 12) pilots' cabin floor; 13) cover; 14) corrugated panel; 15) section; 16 and 25) wing centre section -to-fuselage attachment fittings; 17) walkway; 18) access doors; 19) fuel contents gauge access door; 20)oil tank filler neck access door; 21)brackets for attaching front cabin pilot's seat adjustment shaft;

[redacted] 25X1

25X1

22) oil cooler air scoop; 23) stick control torque shaft [illegible]ment bracket; 24) front spar; 26) fuel tank support [illegible]ction; 28) nose rib 2; 29) front stringer. 25X1

The center section rear spar is a channel section beam made of a duralumin sheet, 2 mm. thick. The upper cap of the spar is reinforced along the entire length with a 38x38x3di[illegible] duralumin angle, and between the wing centre section - to-fuselage attachment fittings with Пр 110-2 sections. The lower cap, between ribs 3 and 4, is reinforced with duralumin strip, 3mm thick. The spar web is reinforced with vertical sections; near the out-out for the stick control torque shaft the web is reinforced with a duralumin plate. Steel outer wing panel and fuselage attachment fittings are mounted on the spar.

The wing centre section beam-type duralumin ribs are made in three parts: nose rib, intermediate and rear ribs. Rib 2 lacks the intermediate part. The lower parts of the No.4 rib noses have cut-outs for the main L.G. wheels.

The intermediate portions of ribs 3 and 4 are of Λ - section. The upper and lower caps of the ribs are made of pressed angles , and the webs - of duralumin sheets reinforced with duralumin sections.

The main gear struts attachment fittings are mounted on the webs of these spars (closer to the rear spar).

Fuel tank cells are located between ribs 1 and 3. The fuel tanks are secured with straps to two supports of the wing centre section. Removable panels underneath the fuel tank cells are secured to the lower caps of the spars and ribs by screws and anchor nuts.

An oil cooler is installed in the leading edge. In the leading edge skin, in the region of the oil cooler, there is a cut-out for removable air scoop. The oil cooler outlet duct is secured by a slotted ring to the spar web and by screws and anchor nuts to the fuel tank access panel. The panel is provided with a cut-out and an adjustable shutter to regulate the outlet duct area.

The main L.G. struts with their brace struts and operating jacks are placed in the section between ribs 3 and 4.

25X1

The wing centre section duralumin skin is riveted to the framework. The upper skin between ribs 3 and 4 is reinforced with sections and duralumin edging.

The wing centre section skin is provided with quick release access doors.

The location and purpose of the access doors is shown in Fig. 6 and 27.

The floor of the rear cabin riveted of sheets and sections is installed on the wing centre section and attached to the webs of rib 1 and to the rear spar.

Fittings for attaching the front seat adjusting shaft are riveted to the floor of the pilots' cabin.

The stick control torque shaft and landing flap jack attachment fittings are mounted on the wing centre section spars.

Two aluminum walkways with corrugated surface are installed on the wing centre section. An entry step welded of steel tubes is mounted on the trailing edge and rear false spar under the lower left portion of the wing centre section.

OUTER WING PANEL.

The outer wing panel framework comprises two spars, 16 ribs and 4 interspar ribs and is braced with 16 steel wires, placed diagonally between the interspar ribs.

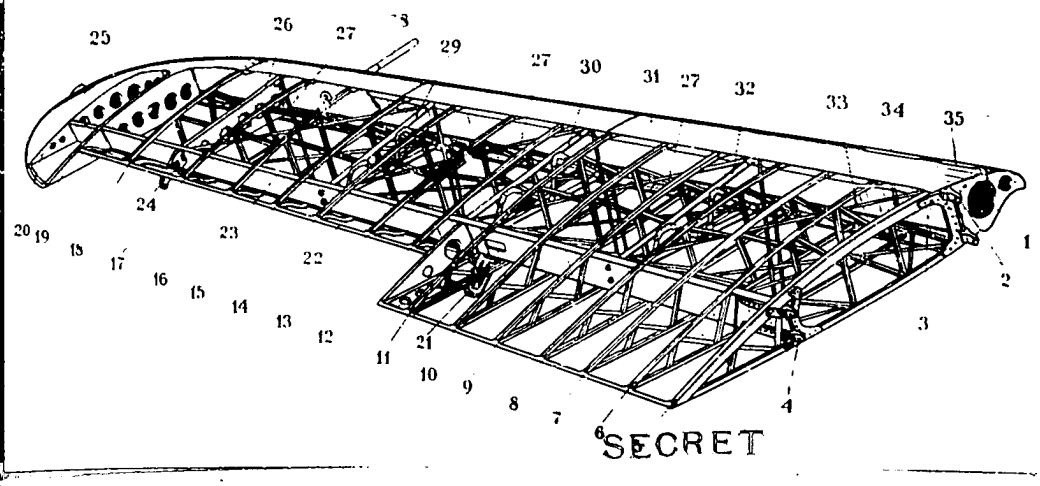


Fig. 7. Outer wing panel (without fabric covering).

25X1

SECRET

1) No.5 nose rib; 2 and 4) outer wing panel -to-centre section attachment fittings; 3) front spar; 5 - 20) ribs [illegible]20); 21) access door; 22) aileron fairing; 23) rear spar; 24) aileron hinge; 25) navigation light; 26,29, 30 and 32)interspar ribs; 27 and 33) bracing wires; 28) pitot static tube boom; 31) L.G. section; 34 and 35) removable glass panels of landing and taxing lights.

25X1

The front spar is riveted duralumin beam of varying section, it consists of a web and two caps. The web is made in two parts, riveted to each other between ribs 11 and 12.

The spar caps are made of Пр 100-15 sections(between rubs 5 and 17, along the upper and lower rear caps and between ribs 5 and 12, along the upper front cap) and a sheet plate, 5mm thick(between ribs 16 and 18) is of channel section and made of a 2 mm thick sheet.

The aircraft mooring brackets are mounted on the spar, between ribs 13 and 14.

The channel section rear spar is made of sheet duralumin. The upper cap up to rib 12 is reinforced with a 3 mm. thick duralumin angle. The spar is built up of two parts overlapped between ribs 14 and 15. The wing outer panel -to--centre section attachment fittings, made of steel are bolted to the wing outer panel spar.

The ribs are made of duralumin. Fourteen split ribs (from 5 to 18) have stamped sheet noses. Thirteen truss--type ribs (from 6 to 18) are riveted of П-shaped sections. The ribs are attached to the spars by means of lugs.

Between the rear portions of rib 12 and interspar rib 2 is a false spar provided with a door permitting access to the aileron bell cranks.

The caps of truss-type carrying rib 5 are made of [illegible]-shaped sections, the struts and brace struts - of pressed sections. Rib 5 is reinforced with 6 tubular brace struts.

The bottom of the nose rib has a cut-out for the main L.G. wheel.

SECRET

25X1

The wing tip riveted to the wing outer panel framework comprises ribs 19 and 20, two spars, the bow and skin.

[redacted]6AH0-45 navigation light is mounted on the bow of [redacted]g tip.

Three truss-type interspar ribs are made of duralumin tubes. The bosses of the ribs are fixed by the stops, mounted on the caps of the front and rear spars.

Interspar rib 4 stamped of a sheet, 2mm. thick, is bolted to the spars by means of angles.

The wing tip is covered with a duralumin sheet, which is secured by rivets with countersink heads.

The ФР-100 taxing light is installed in the left wing outer panel; the ФС-155 larding light - between ribs 6 and 7. The pitot static tube attachment bracket is mounted on No.17 nose rib.

The wing outer panel framework is covered with fabric attached to the ribs with McKey threads.

The wing outer panel fabric covering is coated with varnish and enamel.

3. AILERONS.

The wing is fitted with slotted ailerons having 22% axial balance. The ailerons are made of duralumin.

The aileron framework (Fig.8) consists of a 35x32 mm. tubular spar, nine ribs and trailing edge stringer.

The ribs are attached to the spar by angles. The aileron leading edge is covered with a duralumin sheet; the framework is covered with fabric, which is varnished and enamelled.

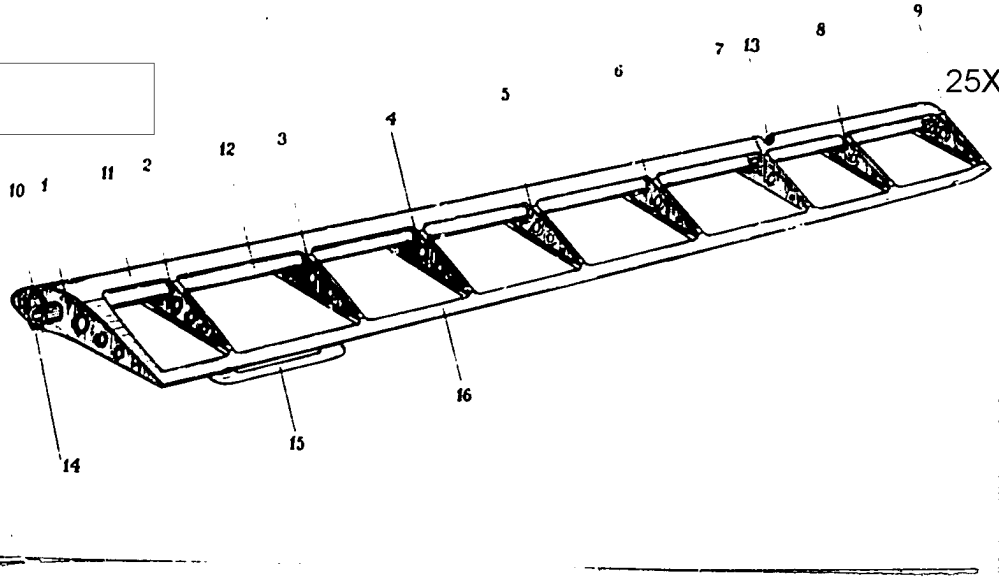


Fig. 8. Aileron framework.

1 - 9)Ribs; 10) bracket; 11) L.G. fairing; 12) spar; 13 and 14) hinges; 15) balance tab; 16) T.E.stringer.

The aileron is attached to the wing by two hinges fitted with ball bearings. One hinge is riveted to the rear portion of the wing outer panel interspar rib 2, the other is secured by eye bolts, attaching the outer wing interspar rib 4, and can rotate about the attachment bolt. The ailerons trailing edge is fitted with balance tabs.

4. LANDING FLAP.

To decrease the landing speed a shrank-type, flap is mounted on the wing centre section, spanwise.

The landing flap is a duralumin riveted structure incorporating a channel-section spar, ten stamped ribs and Z -shaped reinforcing noses, rear stringer, upper box and sheet skin.

[redacted] 25X1

SECRET

A welded bracket for the flap jack rod attachment is installed on rib 4 in the wing centre section.

The flap is hinged to the wing centre section rear spar; [redacted]ge fittings are joined by a pin.

25X1

5. TAIL UNIT.

The aircraft braced tail unit consists of a stabilizer, elevator, fin and rudder. Attachment fittings, brace struts and bracing wires secure the fin and stabilizer to the fuselage. All the tail unit components are covered with fabric which is varnished and enamelled.

STABILIZER.

The stabilizer framework (Fig.9) comprises two spars, ten ribs, two interspar ribs and eight bracing wires.

The front and rear spars, made of a duralumin sheet, 1 mm. thick, consist of two halves assembled together by riveted splice plates.

The ribs are stamped of a duralumin sheet. Ribs 1,3 and 5 are riveted to the spars together with lugs for the bracing wires and attached by knees to the rear spar.

A duralumin-sheet leading edge fairing is riveted to the front spar. The stabilizer tips are riveted to the rear spar and caps of the end ribs. Three fittings for attachment to the fuselage are installed on the stabilizer: two - on the front spar, at rib 1 and one - on the rear spar, at the aircraft centre line.

The stabilizer is connected to the fuselage by brace struts and bracing wires and to the fin - by bracing wires; their attachment lugs are fitted on the spars, on ribs 3. Five hinges for the elevator attachment are mounted on the rear spar.

[redacted] 25X1

18

25X1

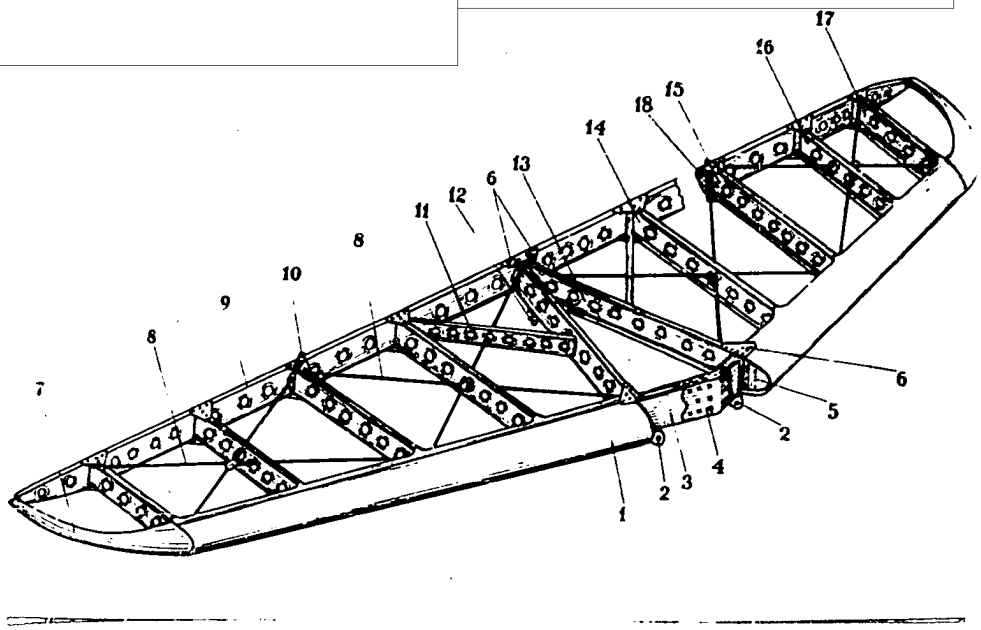


Fig. 9. Stabilizer framework.

1) L.E. fairing; 2) stabilizer-to-fuselage attachment fittings, front; 3) front spar; 4) splice plate; 5) nose; 6) knee; 7) bow; 8) bracing wires; 9) rear spar; 10) bracing wire attachment lug; 11) interspar rib; 12) stabilizer-to-fuselage attachment fitting, rear; 13 - 17) ribs; 18) elevator hinge.

ELEVATOR.

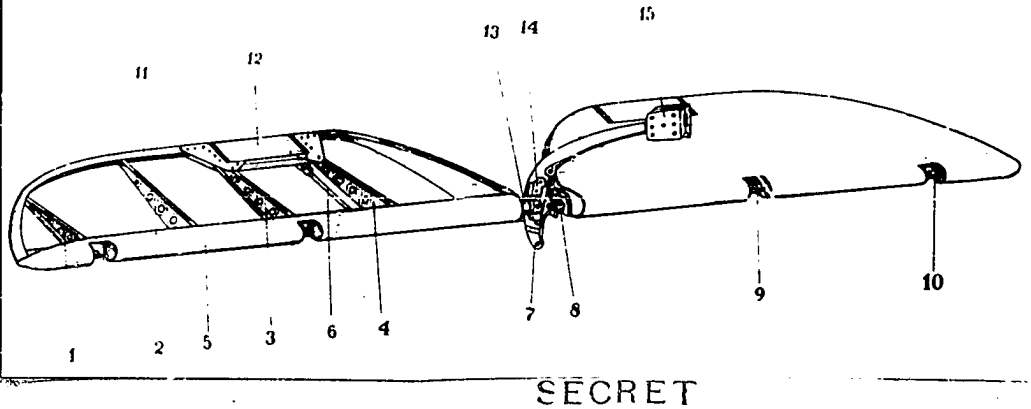


Fig. 10 . Elevator.

25X1

SECRET

1-4) Ribs; 5) L.E. fairing; [redacted] control rod; 7)lever; 8) trim tab control drum; 9 and 10) elevator hinge ;11) bow; [redacted] tab; 13) spar; 14) flange; 15) balance weight.

25X1

The elevator (Fig.10) is built in two identical halves assembled by five bolts and flanges riveted to the elevator spar. The elevator control lever, made of a duralumin sheet, 3mm.thick, is bolted between the flanges.The lever is provided with three lugs: one, with a built-in ball bearing, for the elevator-to-stabilizer attachment; two, with pressed-in brass bushings, for the elevator control cable rods connection.

The elevator balance weight is placed on the upper lengthened end of the lever.

The framework of each half of the elevator incorporates a 35x31 mm. tubular duralumin spar, four ribs riveted to it and a bow connecting the spar to the rib tips.

The nose ribs with duralumin skin riveted to them form the elevator leading edge fairing.

A trim tab is hinged between ribs 1 and 2. The trim tab is controlled by rods running from the control bellcrank mounted on the elevator spar.

The elevator is attached to the stabilizer by five hinges: one of them (centre) is located on the elevator control lever, the remaining four are located on either half of the elevator (two - on each half).

FIN.

The fin framework (Fig.11) consists of two spars,five ribs and two intercostal ribs. A duralumin sheet,1.5 mm thick is used for the front spar, a sheet, 1.2 mm thick - for the rear spar. A L.E.- fairing made of a duralumin sheet,0.8mm thick, is riveted to the front spar and nose ribs.

The front fin attachment fitting is a fork formed by the spar webs. The fork is reinforced with duralumin and steel plates. The rear assembly is formed by the spar caps, steel bow and a hinge for the rudder attachment. Three hinges for the rudder attachment and the bracing wire attachment lugs are fitted on the rear spar.

All the ribs are made of duralumin.

SECRET

[redacted]

25X1

[redacted] 25X1

SECRET

The lower rib has a cut-out for the elevator balance weight; the caps of this rib are reinforced with duralumin

[redacted] 25X1

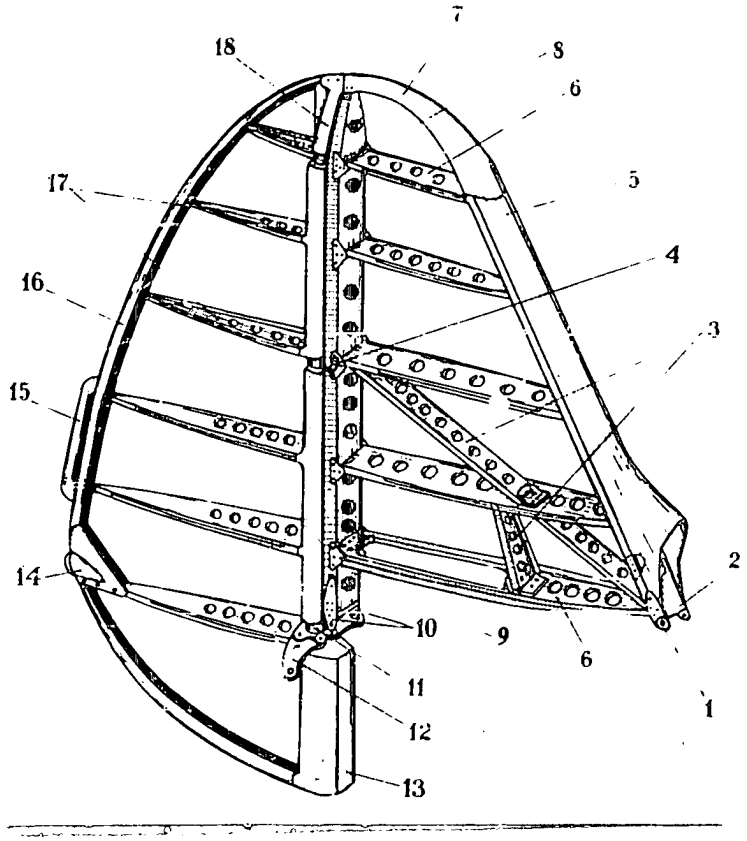


Fig. 11. Fin and rudder framework.

1 and 10) Fin-to-fuselage attachment fittings; 2)fin front spar; 3) intercostal ribs; 4) bracing wire attachment lug; 5) L.E. fairing; 6) rib; 7) bow; 8) knee; 9)rear spar; 11) rudder spar; 12) lever; 13 and 18) rudder L.E. fairing; 14) tail navigation light; 15) balance tab; 16 and 17)ribs.

The rudder framework (Fig.11) consists of a tubular duralumin spar, six ribs and bow. A fairing made of a sheet 0.8 mm. thick,is riveted to the nose ribs. Three hinges for the rudder attachment are mounted on the spar. The upper, middle and lower hinges are riveted to the rudder spar. To the lower hinge is welded a flange for the rudder control lever attach[redacted] 25X1

SECRET

The lever is made of a duralimin sheet, 6 mm thick and is secured to the fuselage by 4 bolts. A steel pin [redacted] lded to the flange. The lower part of the pin is [redacted] ded for the rudder attachment nut. 25X1

The tail navigation light and balance tab are mounted on the rudder rear bow.

III. LANDING GEAR.

The aircraft has a retracable three-wheel landing gear. The landing gear is provided with an air-oil shock absorbers and consists of the nose strut with a 400x150 wheel and two main struts with 500x150 wheels.

The main wheels are equipped with brakes.

The nose L.G. retracts backwards into the well, the main L.G. - forward into the wing centre section nose. In flight about half of each wheel remains exposed, which permits the aircraft to land with the landing gear "up".

The landing gear struts are retained in the "up" position by locks. The locks of the main L.G. are fitted to the lower cap of the wing centre section front spar.

When retracting the L.G., the hook of the lock engages the bolt of the bracket welded on the shock strut lower cylinder.

The nose gear lock is fitted to the lower tube of the fuselage frame 1. When retracting the nose gear, the hook of the lock engages the middle part of the bolt connecting the links of the shock strut torque scissors.

The L.G. struts are fixed in the "down" position by ball locks of the L.G. jacks and by knuckle brace struts which are held in place, when an external force affects the wheels.

The landing gear is retracted and extended by jacks actuated by compressed air.

The landing gear position is checked by the pin mechanical indicators on the wing centre section and the fuselage and by the warning lights on the instrument panels.

SECRET

[redacted] 25X1

SECRET

The L.G. "up" position limit switches are mounted on the "up" locks and operated by the hooks of the locks.

The L.G. "down" position limit switches are mounted on [illegible]ts, fitted on the wing centre section rib 3 - for the main gear, and on the lower tube of the fuselage frame 1 - - for the nose gear.

The switches are operated by special screws of the brace struts upper links.

25X1

L.G. MAIN DATA

Name	Nose Gear	Main gear
1. Shock absorbers	pneumatic--hydraulic	pneumatic--hydraulic
2. Air pressure	17 kg/cm^2	20 kg/cm^2
3. Fluid components	20% of alcohol 70% of glycerine 10% of water	20% of alcohol 70% of glycerine 10% of water
4. Fluid volume	420 cm^3	270 cm^3
5. Rod maximum stroke	170 mm.	220 mm.
6. Rod rated stroke	150 mm	193 mm.
7. Rod stroke force:		
initial	370 kg.	440 kg.
final (at rod rated stroke)	1060 kg.	1370 kg.
8. Air pressure in wheel tyres	2 kg/cm^2	2.5 kg/cm^2

SECRET

25X1

SECRET

[redacted] MAIN GEAR STRUTS. [redacted] 25X1

25X1

The main gear braced struts with the half axle mounted wheel consist of shock struts, knuckle brace struts and operating jacks.

The wheels are equipped with brakes.

The shock strut (Fig.12) comprises the upper and lower cylinders and a rod, at the top of which is a piston, at the bottom - a half-axle fitted with a flange for the wheel attachment.

The cylinders are connected by a castle collar with right-hand and left-hand threads.

The rod piston consists of two bronze rings provided with holes 4 mm. dia. The upper ring has 28 holes, the lower - - 30 holes.

Between the rod rings are a floating ring valve with four holes 2 mm. dia., communicating by a groove. The pistons-to-the rod connection is threaded; the pistons are locked by two screws, placed between the holes of the upper ring.

The rod is a hollow cylinder; the rod inner chamber is separated from the operating chamber of the upper cylinder by a hermetically welded plug.

Between the cylinder and the rod is a sealing pack consisting of three leather sealing washers and distance rings. They are tightened by a nut locked with a screw through the upper cylinder wall.

The shock strut lower cylinder is a hollow cone. A bronze bushing serving as a guide for the rod is pressed in the lower end of the cone. A bracket fixing the shock strut in the "up" position is welded to the cylinder lower portion.

The upper cylinder is hollow. The piston with the rod travels inside it. A fork for the shock strut-to-the wing centre section attachment is welded to the upper end of the cylinder. A lever with a ball hinge for the jack attachment is welded to the shock strut fork. A bracket for the brace struts attachment is welded to the cylinder bottom.

SECRET

[redacted] 25X1

SECRET

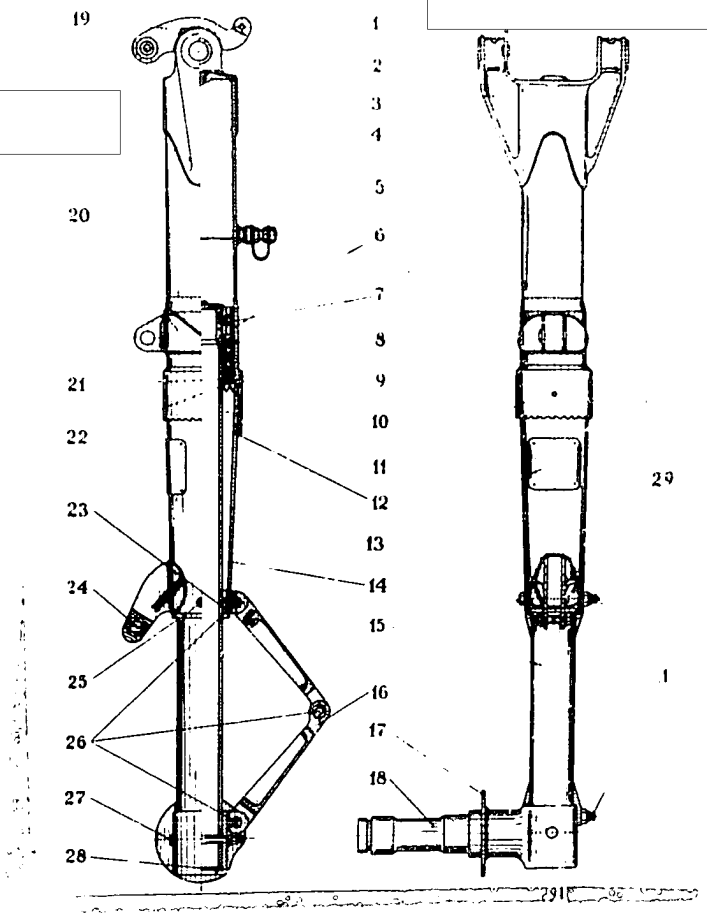


Fig.12. L.G. Main shock strut.
1)Grease cup; 2) bushing;3) shock-strut fork;4)upper cylinder; 5) charging valve; 6) piston; 7) valve; 8) leather washer; 9) distance ring; 10) locking screw; 11) collar; 12) stop; 13) instruction plate; 14) lower cylinder; 15) rod; 16) torque links; 17) wheel brake attachment flange; 18) half-axle; 19) jack and mechanical indicator attachment bracket; 20) brace strut attachment bracket; 21) felt gland; 22) nut; 23) bushing; 24) bolt; 25) grease cup; 26) torque links bolts; 27) tapered bolt for half axle-to-rod attachment; 28)plug; 29) bracket.

SECRET

SECRET

The upper cylinder inner chamber above the rod is filled compressed air and AM7C/10 fluid. When the wheel im- 25X1
against the ground the rod moves up and presses the air. Simultaneously the fluid presses on the valve and flows through the holes in the piston.

On impact the compressed air tends to expand and return the rod to its initial position; the fluid presses the valve to the piston upper ring and flows into the upper chamber only through four holes of the valve.

When the fluid flows through small holes in the valve, considerable hydraulic resistance dampens the reverse stroke impact.

The strut is charged with air through the valve. The fluid is filled through the connection hole, with the valve being removed. This hole is also used for checking the level of the fluid. The main shock struts are hinged between the wing centre section ribs 3 and 4 on hollow axles secured by tapered bolts in the wing centre section brackets.

The knuckle strut consists of two links hinged to each other by a hollow bolt.

The upper link is welded of three tubes forming a triangle, one angle of which is hanged to the fitting on the wingcentre section front spar, the second - to the jack rod, and the third - to the brace strut lower link. The brace strut lower link is a steel forging, one end of which is provided with a ball hinge for the brace strut-to-shock strut attachment.

The jack is attached to the shock strut fork lever and to the upper link of the knuckle brace strut. The jack is a hollow cylinder inside which a piston with a rod travels.

The jack is provided with a ball lock fixing the jack rod in the "up" position.(Fig.13).

SECRET

25X1

SECRET

25X1

25X1

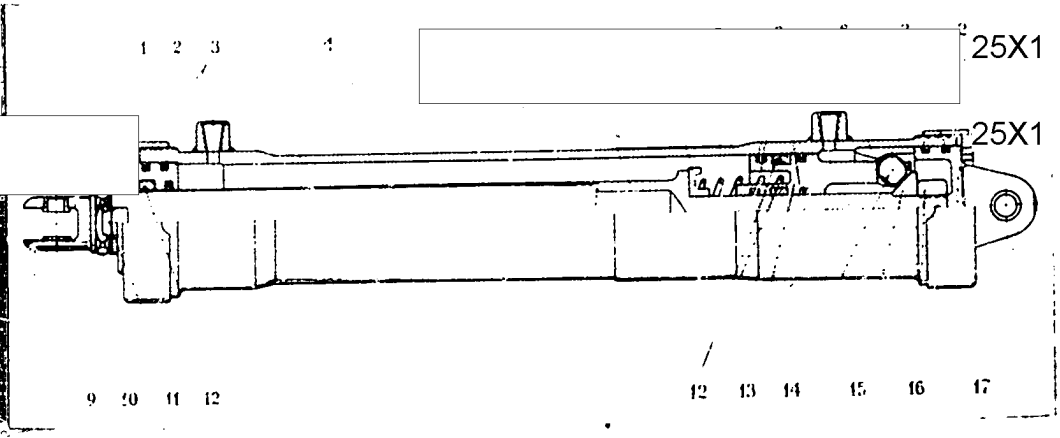


Fig. 13. Main gear operating jack.

1) Collar; 2) nut; 3) rubber sealing rings; 4) cylinder; 5) rod; 6) support ring; 7) spring; 8) and 15) tapered rings; 9) fork bolt; 10) locking nut; 11) lock washer; 12) felt glands; 13) piston; 14) ball; 16) nut; 17) fork.

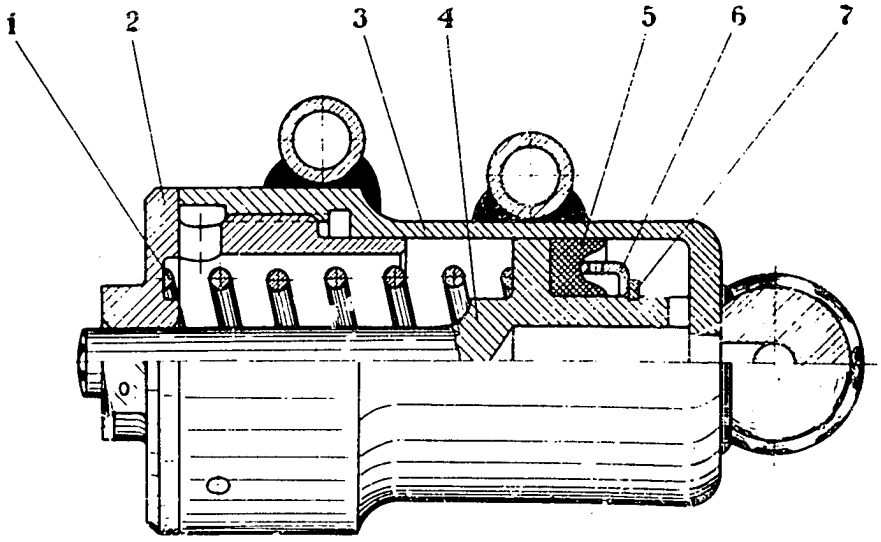


Fig. 14. L.G. lock operating jack.
1) Spring; 2) nut; 3) case; 4) rod; 5) rubber washer; 6) ring; 7) spring ring.

SECRET

25X1

SECRET

When retracting the landing gear, the compressed air enters the jack cylinder, moves the piston, which presses ing, releases the balls located between the outer and inner tapered rings on the rod and moves the rod. The rod, pressing on the brace strut upper link, turns it about the brace strut-to-wing centre section attachment bolt and makes the shock strut turn about the suspension axle until the bolt mounted on the lower cylinder bracket engages with the L.G. "up" lock hook.

When extending the landing gear, the compressed air enters simultaneously both the L.G. jack cylinder and the L.G. "up" lock cylinder (Fig.14).

The lock operating jack rod extends and turns the latch, thus releasing the hook which opens by the spring action and weight of the shock strut.

The shock strut is extended, rotating about the axle until the jack ball lock closes.

500x150 wheels equipped with tyres and pneumatic brakes are mounted on the main L.G. shock struts.

The brake case is secured to the shock strut half-axle flange by six bolts. The wheel with tyre is mounted on the shock strut half-axle and is secured by a nut screwed on the half-axle end.

The nut is located by a bolt. The pneumatic brakes are operated from the both cabins by compressed air.

The compressed air under a pressure, reduced in the ПУ-6 valve to 8 kg/cm^2, passes through the differential control unit to the brake expander tubes. The brake rubber expander tubes expand and press plastic brake shoes to the wheel brake drum providing the required brake power. After the pressure is released the brake shoes are disengaged from the wheel brake drum by return springs.

The clearance between the brake shoes and the wheel brake drum are not adjusted, the minimum permissible clearance between them with the brakes released being 0.05.

SECRET

25X1

SECRET

[redacted]

NOSE GEAR STRUT

[redacted]

25X1

The nose gear of a braced type consists of a shock strut, knuckle brace strut and operating jack.

The principle of operation of the nose gear shock strut (Fig.15) is similar to that of the main gear shock strut.

The nose gear leg consists of a cylinder, shimmy damper, wheel and rod, the upper end of which is fitted with a piston, the lower - with a fork for the wheel mounting. The cylinder is hollow with a piston and rod travelling inside. The fork for the shock strut-to-fuselage attachment is welded to the top of the cylinder. The brace strut and shimmy damper attachment bracket is welded to the cylinder lower part. A collar connected by the torque links to the rod and by a lever to the shimmy damper is secured to the cylinder lower part by a nut.

The collar serves to transmit the wheel and fork shimmies to the shimmy damper. The nose wheel can turn in both directions at an angle of 55°.

In the nose gear shock strut is a mechanism setting the wheel in the neutral position after external loads have ceased to affect the wheel. The mechanism consists of two cams with curvilinear cut-outs matching each other.

The lower cam is splined to the cylinder, the upper cam is secured to the rod by two screws. To decrease friction the upper cam is made of bronze, the lower-of steel.

SECRET

[redacted]

25X1

SECRET

25X1

25X1

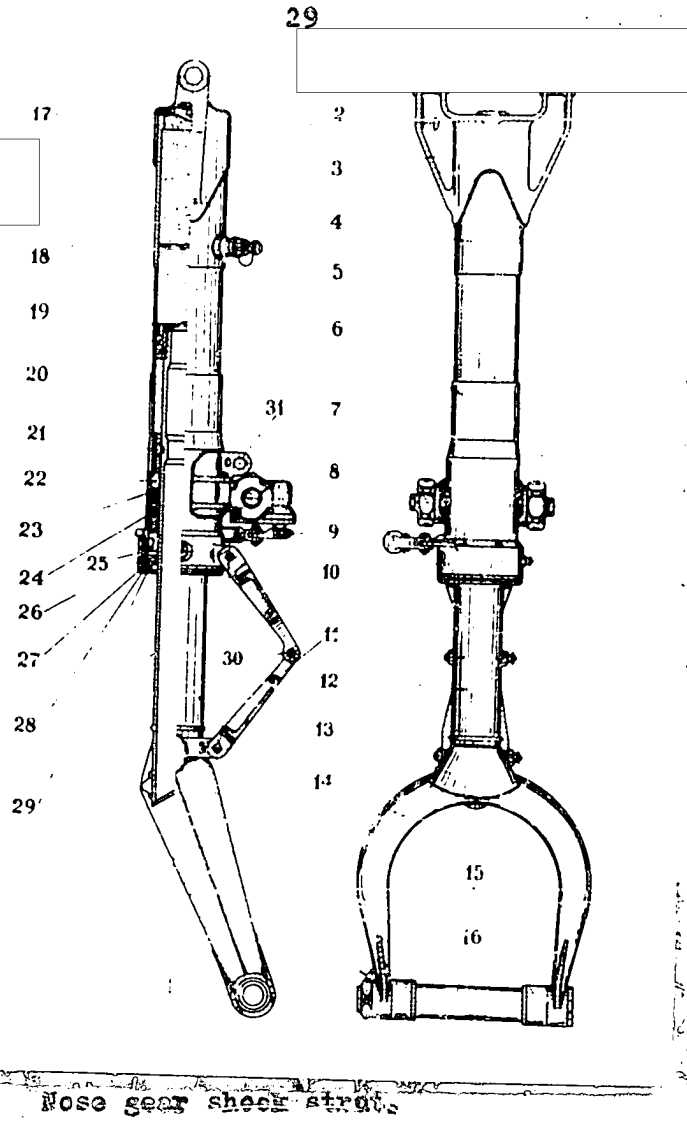


Fig. 15. Nose gear shock strut.

1) Bushing; 2) mechanical position indicator bracket; 3) shock strut fork; 4) cylinder; 5) charging valve; 6) instruction plate; 7) shimmy damper; 8)and 9)shimmy damper levers; 10) collar; 11) torque links; 12) rod; 13) angle; 14) fork; 15) bushings; 16) wheel axle; 17) cylinder head; 18) piston; 19) valve; 20) upper cam; 21) upper cam-to-rod attachment screw; 22) lower cam; 23) distance ring; 24) leather washer; 25) bushing; 26) [illegible]; 27) felt gland; 28) nut; 29) locking screw; 30) torque link bolts; 31) brace strut attachment bracket.

SECRET

25X1

The sealing pack is similar to that of the main gear shock strut.

[redacted]ass bushing serving as a guide for the rod is mounted in the cylinder lower part.

The sealing pack, lower cam and the guide bushing are tightened with a nut which is locked by a screw.

The nose gear shock strut is hinged by two bolts, having holes for lubricant, to the fittings welded to the fuselage tubular frame "0".

The knuckle brace strut consists of two links hinged to each other by a hollow bolt.

The upper link is built up of two tubes welded to the fork by means of angles. One end of the fork is fitted with lugs for the jack attachment, the other - with lugs for the brace strut lower link attachment. The ends of the tubes are fitted with lugs for the brace strut attachment to the fittings welded to the lower tube of the fuselage frame 1.

The lower link is a tube with lugs welded to it; one lug has a ball hinge for the brace strut-to-shock strut attachment.

The jack is attached to the lug of the brace strut upper link and to the fitting welded to the upper tube of the fuselage frame "0". The jack is a hollow cylinder with a piston and rod travelling inside.

The jack is provided with a ball lock, fixing the rod in the "down" position.

The extension and retraction of the nose gear is similar to that of the main gear.

4. NOSE-WHEEL SHIMMY DAMPER.

The nose-wheel shimmy damper (Fig.16) is a fixed cylinder with a piston travelling inside of it; the piston is connected by means of a lug, levers, rim and torque link with the wheel fork of the shock strut.

[redacted]

SECRET

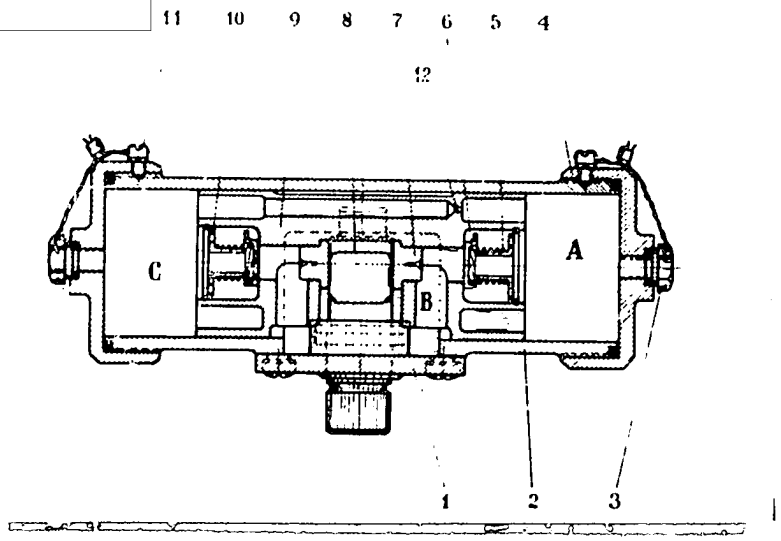


Fig.16. Shimmy damper.

1) Cover; 2) case; 3) plug; 4) nut; 5) spring; 6) valve; 7) insert; 8) lug; 9) piston; 10) stop; 11) locking screw; 12) mittering hole in the piston.

A and C - operating chambers;
B - auxiliary chamber.

The cylinder is filled with alcoholglycerine fluid.

The inner chamber of the cylinder is devided by the piston into three parts.

The oporating chambers communicate through a mittering hole in the piston.

The center (auxiliary) chamber communicates with the operating chambers through by-pass valves. When the wheel oscillates, the lug moves the piston from side to side and the fluid passes through the piston mittering hole.

Hydraulic resistance absorbs oscillations of the wheel shock strut when the fluid passes through the piston hole.

SECRET

IV. CONTROL SYSTEMS.

The aircraft has dual control system which permits to control the aircraft from both front and rear cabins (Fig. 17, 18).

The aircraft is provided with stick and pedal controls. The ailerons and elevator are controlled by stick, the rudder - by pedals.

1. STICK CONTROL.

The elevator control is by rods running in the cabin and by cables from a bell crank on fuselage frame 4 to the elevator.

The elevator and ailerons are operated by control sticks mounted on the torque shaft in the front and rear cabins.

The torque shaft consists of two welded steel brackets and duralumin tube riveted to the bracket sleeves. The bracket sleeves are welded to two pivots serving as axles of rotation when moving the control sticks right or left. The pivots are inserted in the supports mounted on the wing center section spars. The supports are fitted with built-in ball-bearings.

Each control stick consists of a duralumin tube, ebonite handle and stamped arm attached by bolts. The bolt in the bracket lugs and arm fulcrum serves as an axle of rotation when moving the control stick backward or forward. The arm fulcrum is fitted with built-in ball-bearings.

The arm lower ends of the control sticks are connected by an adjustable rod which runs inside the torque shaft. The arm lugs are fitted with built-in ball-bearings; the rod is hinged to the arm second lug in the rear cabin; the other end of the rod is connected to the bell crank on fuselage frame 4.

SECRET

The bell crank mounted on fuselage frame 4 is connected to the elevator lever by means of two steel cables 3.5mm in diameter.

Each control stick is provided with a L.G. wheel brake control lever. An air valve built in the control stick handle in the rear cabin is controlled by a button. Using this button the instructor can correct the student's improper application of brakes.

The control stick moves 20°30' backward to move the elevator 25 deg. up; the stick moves 16°30' forward to move the elevator 20 deg down.

The elevator maximum movement up and down is restricted by two adjustable stops mounted on the torque shaft front bracket.

The ailerons are controlled by rods. Two lengthwise adjustable rods are connected to the rocker of the torque shaft support bracket. The other ends of the rods are connected to the bell cranks mounted on the wing center section rear spar near the break line of the wing senter section and outer wing panel.

Two circuits consisting of three rods each run from the bell cranks to the right and left wing ailerons.

The rods run inside the wing and are connected by the bell cranks mounted on the wing rear spar.

The rocker and bell cranks provide differential movement of the ailerons.

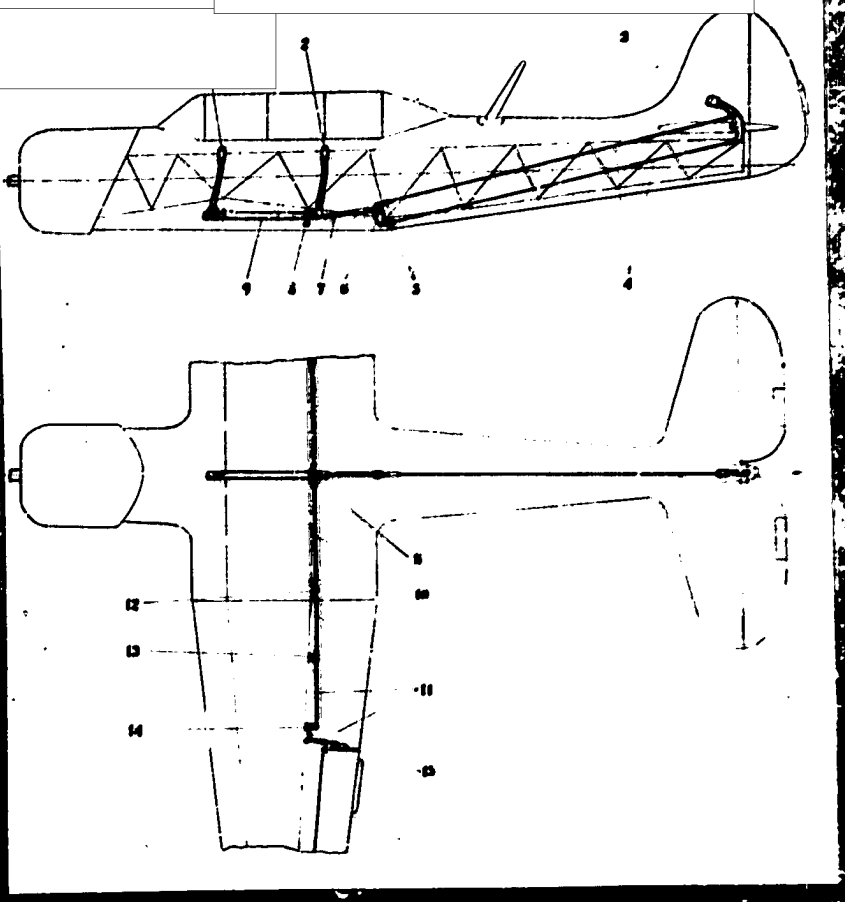
The control stick movement from the neutral position moves one aileron up through a larger angle than the other down.

The control stick moves a total of 18° right and left to move the ailerons 22 deg. up and 15 deg. down.

The ailerons maximum movement is restricted by two adjustable stops mounted on the rocker of the torque shaft rear support bracket.

The stops rest against the bracket mounted on the wing center section rear spar web.

SECRET



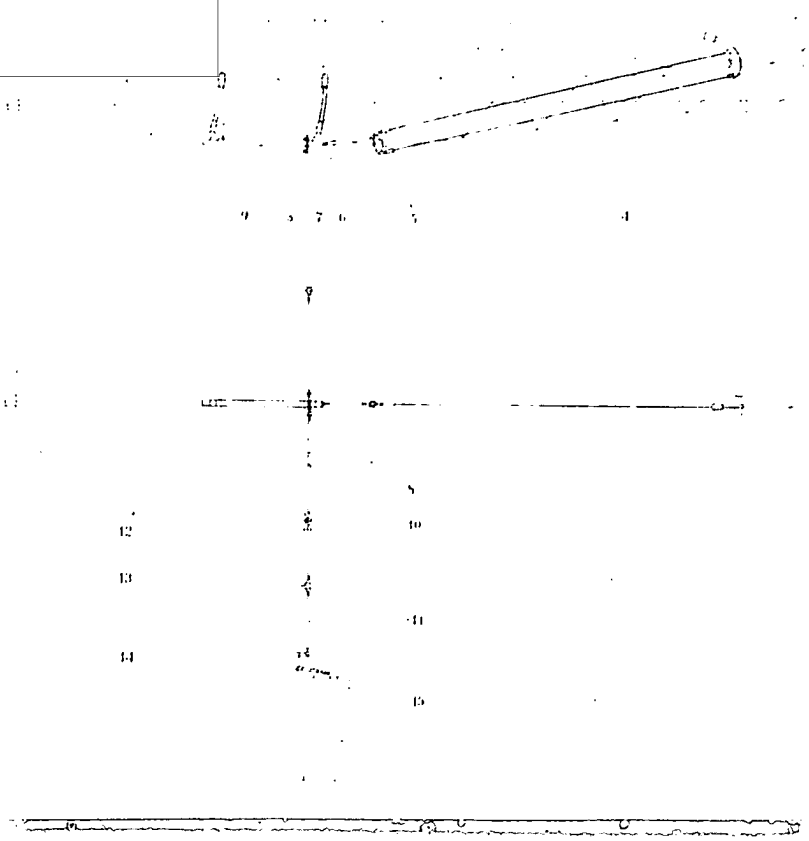


Fig. 17. Elevator and aileron control diagram.

1) and 2) Control sticks in the front and rear cabins; 3) elevator control lever; 4) control cables; 5) control cable turnbuckles ; 6) bell crank; 7) tubular rod; 8) torque shaft rocker; 9) torque shaft; 10) and 11) aileron control tubular rods; 12), 13) and 14) bell cranks; 15) aileron control lever.

SECRET

[redacted]

2. PEDAL CONTROL.

Rudder control consists of pedals in the front and rear cabins and cables running from the pedal bell cranks to the rudder control lever.

Pedal control includes a four-link parallelogram interconnect truss mechanism which provides the pedal reciprocal movement.

The pedal securely attached to the bell crank and pedal body rotates in the ball-bearings pressed in the fuselage bracket on frame 1 - in the front cabin and in duralumin panel - in the rear cabin.

The pedals are adjusted for long-and short-leg positions by rotating the worm handle. Pedal adjustment range is 140 mm.

The lever with bolts operating the differential control unit valves is mounted on the pedal axle in the front cabin.

The pedal bell cranks in the front and rear cabins and the pedal bell crank in the rear cabin and the rudder control lever are connected by steel cables, 3 mm. in diameter.

The cables tension is adjusted by turnbuckles.

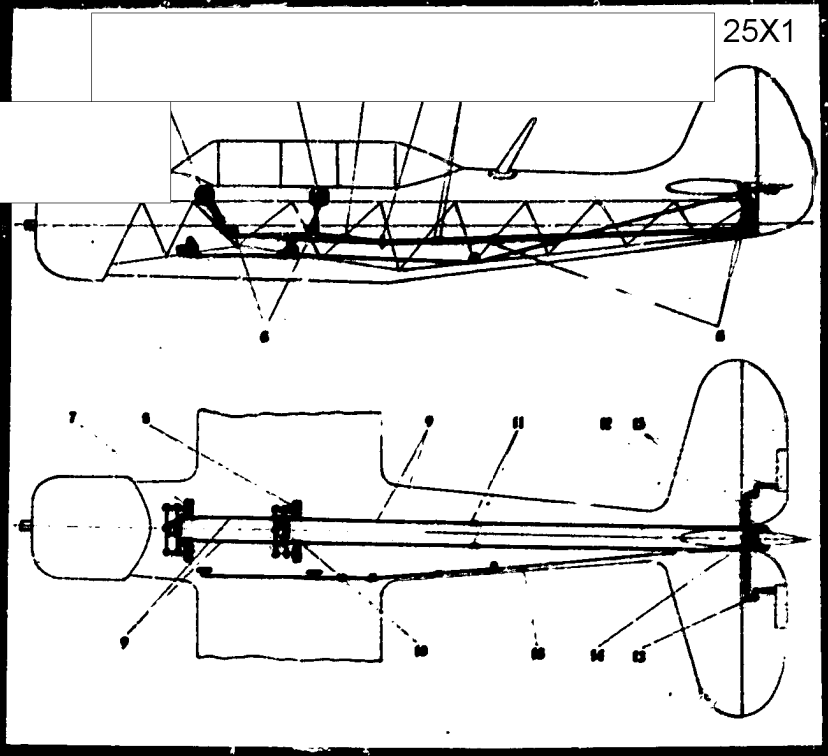
With pedal fore-and-aft movement of 27 deg, the rudder moves 27 deg right or left.

The rudder maximum movement is restricted by adjustable stops, mounted on the pedal bell crank in the rear cabin.

SECRET

[redacted]

25X1



SECRET

[redacted]

25X1

[redacted]

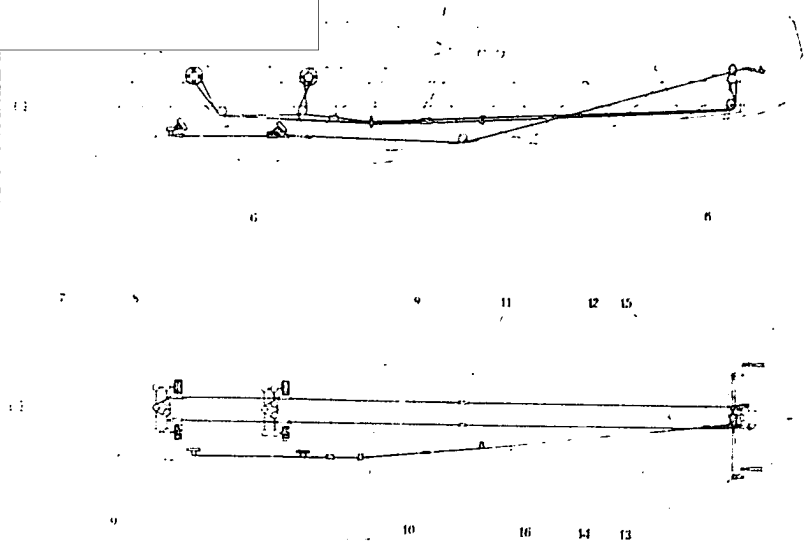


Fig. 18. Rudder and elevator trim tab controls diagram.

1) and 2) Handwheels, elevator trim tab control; 3) limit switch, trim tab control system; 4) fair-lead, trim tab control cable; 5) turnbuckles; 6) guide pulleys; 7) and 8) pedals in the front and rear cabins; 9) pedal control cables; 10) pedal control cable turnbuckles; 11) pedal control cable guide pulleys; 12) rudder control lever; 13) bell crank; 14) drum, trim tab control; 15) tubular rods, trim tab control; 16) cables, trim tab control.

SECRET

[redacted]

25X1

25X1

[redacted] ELEVATOR TRIM TAB CONTROL.

25X1

The elevator trim tab is controlled by the hand-wheels, mounted on the port side in the front and rear cabins. The handwheel with the drum is attached to the bracket mounted on the fuselage upper longeron.

The control cable consists of one steel wire, 7x18-3.5. The handwheel drums are connected to the trim tab actuator drum mounted on the elevator spar via a cable.

The cable tension is adjusted by turnbuckles. The elevator drum axle coincides with the elevator axis of rotation! The worm drive inside the drum converts rotating movement of the drum into reciprocal movement of the worm.

The rods run from the worm ends to the trim tab bell cranks.

With the handwheels movement clockwise, the trim tabs move up, with the handwheels movement counter clockwise, the trim tabs move down.

The trim tab neutral position warning system includes the KB-6A limit switch mounted on the left brace strut bracket of fuselage frame 3.

The KB-6A limit switch is closed by a copper tube soldered to the trim tab control cable. The limit switch operates green warning lights on the instrument panels in both cabins.

4. LANDING FLAP CONTROL.

The landing flap is controlled by compressed air supplied from the aircraft air system.

Pipes from the flap control valves installed on the left control boards on both cabins run to two by-pass valves. These valves permit to control the landing flap from both cabins.

Two hoses run from the valves to the flap operating jack pipe connections.

The flap operating jack is hinged to the bracket on the wing center section rear spar.

25X1 [redacted]

bolt of the jack rod is connected to the bracket on the landing flap spar. When compressed air enters the upper operating chamber of the jack cylinder it presses the piston and moves the rod till the piston reaches the cylinder collar. When the rod moves, it lowers the flap turning it about the hinge. The flap is hinged to the wing center section rear spar.

25X1

The jack rod stroke of 81 mm provides the flap lowering through 50 deg.

The flap position is checked by a mechanical indicator.

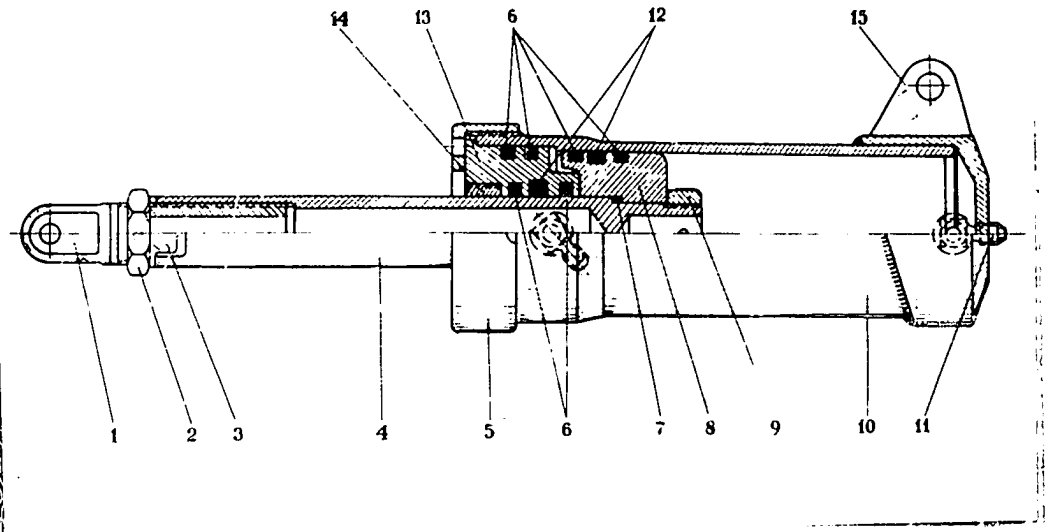


Fig. 19. Flap operating jack.

1) fork bolt; 2) lock nut; 3) locking washer; 4) rod; 5) nut; 6) rubber sealing rings; 7) sealing gasket; 8) piston; 9) nut; 10) cylinder; 11) connection; 12) felt gland; 13) bush; 14) guide bush; 15) jack-to-wing center section bracket attachment lug.

When closed, the flap is pressed tightly to the wing center section by a rubber shock cord which is connected by cables to the eyes riveted to the flap spar.

25X1

SECRET

5. AIRCRAFT AIR SYSTE [redacted] 25X1

The aircraft air system is designed for starting the engine, retracting and extending the landing gear and flap and controlling the wheel brakes.

The air system includes the AK-50M compressor installed on the engine, filters, pressure reducing valve, non-return valves, cocks, pipelines consisting of pipes and flexible hoses, and two ball-shaped air bottles -main, 12-litre capacity and emergency, 3-litre capacity.

The main and emergency air bottles are installed on the lower panel of the fuselage framework aft of the rear cabin seat. While on the ground the air bottles are charged from the ground cylinder through the air supply connection and in flight - from the AK-50M compressor.

The reducing valve discharges the air to atmosphere if pressure exceeds 50 kg/cm^2 for which the valve spring is rated.

Non-return valves pass the air only in the direction indicated by the arrow on the case.

Compressed air is distributed in the air system as follows:

1) To start the engine compressed air is supplied to the air distributor through the pneumatic solenoid- controlled valve installed on the fire wall.

2) Compressed air is supplied to the L.G. retracting jacks and to the L.G. locks operating jacks through the L.G. valves installed on the port side control boards in both cabins. When the L.G. control valve lever in the rear cabin is in the neutral position, the pilot in the front cabin can extend or retract the landing gear.

When the landing gear is incorrectly controlled from the front cabin, the pilot in the rear cabin sets the L.G. control valve lever in proper position, thus correcting the error. In this case the L.G. control valve in the front cabin is cut off from the air system and the landing gear is retracted or extended only from the rear cabin.

SECRET

[redacted] 25X1

[redacted] 25X1

[redacted] 25X1

2) Compressed air is supplied to the flap operating jack [redacted] the flap valves mounted on the port side control boards in both cabins.

4) Compressed air reduced to 8 kg/cm^2 pressure in the ПУ-6 valve which is controlled by the levers located on both control sticks, is supplied to the wheel brakes via the differential control unit.

The differential control unit operated by the pedals provides differential wheel braking.

In emergency (student's incorrect action), the instructor presses the button on the control stick in the raer cabin thus cutting off the air supply to the brake system.

Should the main system fail, the air from the emergency bottle is used.

To extend the landing gear, from the emergency system set the L.G. control valve lever in the neutral position. In this case, compressed air is supplied to the operating chambers of the L.G. lock jack and L.G. operating jack from the emergency air bottle through emergency valves (Fig.21) mounted on the L.G. "up" lock jacks and on the L.G. operating jacks and extends the L.G.; at the same time compressed air is supplied to the flap valves and to the ПУ-6 valve which permits to lower or raise the flap and to apply brakes from the emergency system.

The air pressure in the main and emergency systems is indicated by two-pointer pressure gauges installed on the instrument panels in both cabins.

Emergency extension valves are installed on the port side control boards in both cabins.

The air system pipe lines are painted black. All the pipe lines are connected by coupling with tube ends flared. When assembling the pipe lines, use sealing grease.

[redacted] 25X1

SECRET

25X1

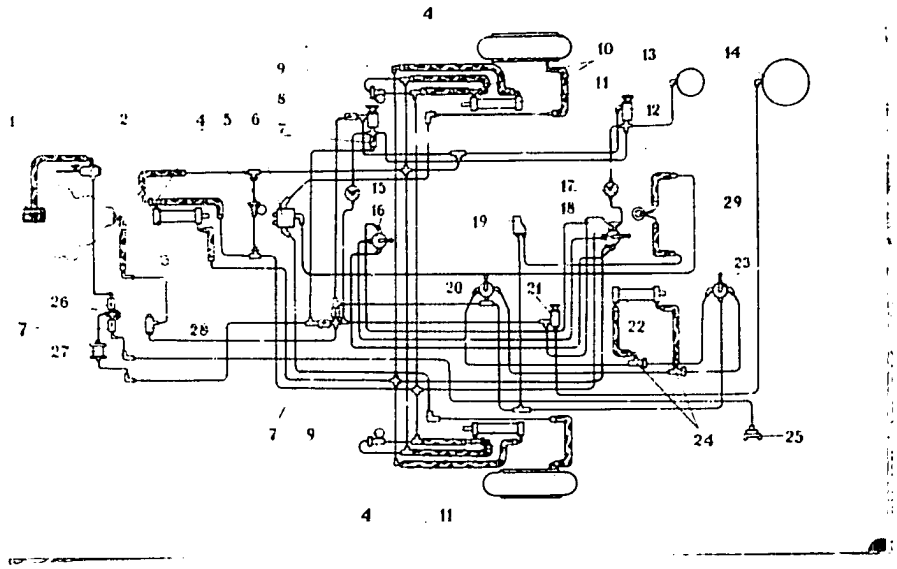
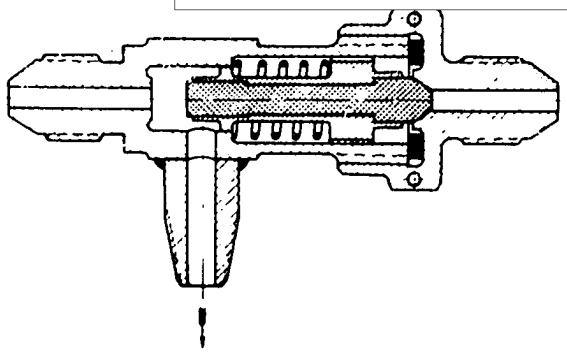


Fig. 20. Air system diagram.

1) AK-50M compressor, engine; 2) filter (sump); 3) hose L.G. operating jack; 4) emergency valves; 5) nose L.G. look operating jack; 6) differential control unit; 7) non-return valves; 8) L.G. emergency extension valve, front cabin; 9) main L.G. lock jack; 10) flexible pipe lines; 11) main L.G. operating jack; 12) L.G. emergency extension valve, rear cabin; 13) main air bottle; 14) emergency air bottle; 15) two-pointer pressure gauge, front cabin; 16) L.G. control valve, front cabin; 17) two-pointer pressure gauge, rear cabin; 18) L.G. control valve, rear cabin; 19) AU-6 reducing valve; 20) flap control valve, front cabin; 21) air system charging valve; 22) flap operating jack; 23) flap control valve, rear cabin; 24) flap valves; 25) air supply connection; 26) reducing valve; 27) strainer; 28) pneumatic double-hold-controlled valve; 29) brake release button, rear cabin control stick.

25X1



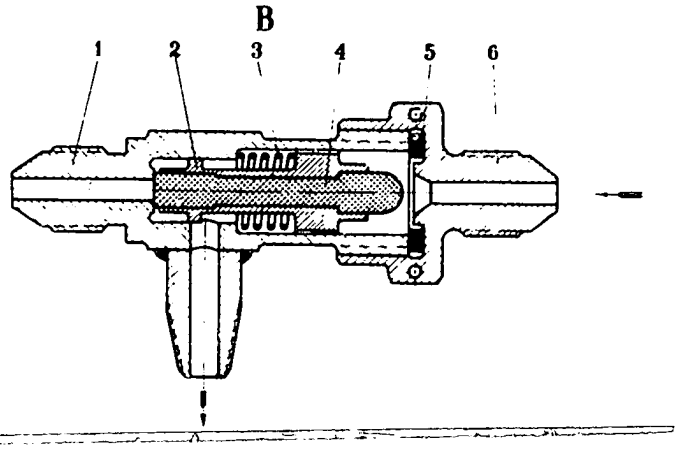


Fig 21. Emergency valve.

A - Slide valve position when operating from the main system.

B - Slide valve position when operating from the emergency system.

1) Valve case; 2) slide valve body; 3) spring; 4) slide valve rubber insert; 5) washer; 6) pipe connection.

SECRET

25X1

asists of the

able pitch

ifold.

-cooled,radial,
carburetor.The
altitudes. It
with an uncon-
loyed to build up
ng, to improve
p the cylinders.
rough a planetary
The reduction

БУМАГА ГАЗЕТНАЯ

51 г/м²

Состав по волокну: целлюлоза небеленая сульфитная — 75% и древесная масса — 25%

linders,crank-
reduction gear

and accessory drives, valve timing mechanism, fuel supply, ignition and lubricant systems.

CRANKCASE.

The crankcase is made of heat treated light alloys and composed of the six sections: the nose section, front cover of the crankshaft thrust bearing, front and rear halves of the crankcase, intake manifold and rear cover.

SECRET

25X1

SECRET

[redacted] 25X1

V. POWERPLANT.

1. GENERAL.

The powerplant of the SK-18A aircraft consists of the following main units and systems:

1. AM-14P engine with B-530 A-35 variable pitch propeller.
2. Engine mount.
3. Cowling and shutters.
4. Carburetor air intake and exhaust manifold.
5. Engine accessories control systems.
6. Fuel system.
7. Lubrication system.
8. Starting system.

2. POWERPLANT DESIGN.

The AM-14P is an internal combustion air-cooled, radial, nine-cylinder, four-stroke cycle engine with carburetor. The engine is not designed for operation at high altitudes. It has a one-speed centrifugal type supercharger with an uncontrollable gear drive. The supercharger is employed to build up manifold pressure at take-off and normal rating, to improve carburetion and distribution of the mixture to the cylinders.

Power to the propeller is transmitted through a planetary type reduction gear with gear ratio of 0.787. The reduction gear reduces the propeller r.p.m.

The engine consists of the crankcase, cylinders, crankshaft and piston rod assembly, supercharger, reduction gear and accessory drives, valve timing mechanism, fuel supply, ignition and lubricant systems.

CRANKCASE.

The crankcase is made of heat treated light alloys and composed of the six sections: the nose section, front cover of the crankshaft thrust bearing, front and rear halves of the crankcase, intake manifold and rear cover.

SECRET

[redacted] 25X1

[redacted] 25X1

The nose section houses the reduction gear which the propeller shaft, three twin planetary gear with axles, stationary sun gear, parts for sealing and distributing the oil delivered to the constant-speed governor and propeller. The front part of the nose section carries the thrust bearing which is designed to take the thrust forces of the propeller and prevent the propeller shaft from longitudinal movement.

The crankcase main section is built up from two halves, front and rear, the joint face being on the centre line of the cylinders; the two halves are assembled by nine bolts and machined as an integral part. The crankcase is fitted with nine flanges to attach cylinders and two glanges to attach the oil sump. The front half wall lug carries the guide push rods and its lateral wall carries the roller bearing, the main support of the crankshaft. The crankcase main section houses the crankshaft and piston rod assembly.

The valve timing drive and the cam disc are installed in the front half wall lug and the cover which carries the thrust ball bearing and the crankcase front section are attached to the front half of the main crankcase by 18 studs. The intake manifold is attached to the rear half of the main crankcase; it collects the mixture supplied through the intake pipes from the supercharger to the cylinders. On periphery of the intake manifold there are nine bosses with threaded holes for the intake pipes of the cylinders; the eight bosses have lugs with holes for engine mount attachment. The adapter with carburetor are attached to the bottom intake manifold flange. The intake manifold carries the supercharger impeller, diffuser assembly, impeller drive shaft and rear cover. The supercharger gear train is mounted on the diffuser.

The rear cover is attached to the intake manifold and carries the following accessories: two M-9 magnetos, GK-1500M generator, AK-50M air compressor, AK-4C vacuum-pump, oil gear pump, 702M fuel pump, air distributor and tachometer drive. The rear cover houses the accessory drives.

Att [redacted] 25X1

SECRET

[redacted]

CYLINDERS AND PISTONS

A cylinder consists of two parts:

[redacted]he steel barrel with a thread for connection to the cylinder head, cooling fins, flange for the barrel-to-crankcase attachment. 25X1

2) the cylinder head made of aluminium alloy; when assembling the cylinder, the heated cylinder head is screwed on the cold barrel.

The cylinder head has vertical and horizontal finning; the top part of the cylinder head forms two rocker boxes. The inner cavity of the cylinder head limited by the piston forms a half-spherical combustion chamber. Attached to each cylinder is the intake pipe by which the mixture is supplied from the intake manifold.

The piston is machined from aluminium alloy stamping; it has four grooves for rings. Compression rings the outer surfaces of which are chrome plated are located in the two upper piston grooves; the oil ring is in the third groove; the tapered oil scraper ring is in the lower groove, the ring tapered top being directed towards the piston bottom. The piston is attached to the connecting rod by a fully floating hollow steel (220)gudgeon pin inserted in the piston special bosses. The pin axial movement is restricted by the two aluminium plugs inserted in the piston.

CRANKSHAFT.

The crankshaft consists of the two detachable parts - front and rear. The front part consists of the main journal with splines on its nose section, crankweb with the attached counterweights and connecting rod journal. The rear part consists of the main journal and crankweb, one end of which is provided with a clamp, the other end - with a balance counterweight held by steel pins. The counterweight counterbalances the inertia forces and serves as a torsional vibration damper. Both parts of the crankcase are assembled together by the bolt, which holds the piston rod journal of the front part in the rear part crankweb clamp.

SECRET

[redacted] 25X1

The main and piston rod journals are hollow and communicate through passages drilled in the front and rear

The crankshaft is installed in the main crankcase and runs in the roller and ball bearings; the axial movement of the crankshaft is restricted by the thrust bearing fitted in the front cover.

REDUCTION GEAR.

The planetary type reduction gear consists of the driving gear splined on the crankshaft front end; propeller shaft with a bell gear which houses three planetary gears mounted on axles, and the stationary sun gear bolted to the crankcase nose section. All the gears are cylindrical. The driving gear and stationary gear consist of hubs and gear tooth rims. The hubs and the rims are coupled by floating involute splines. Each planetary gear consists of a pair of cylindrical gears rigidly splined together.

The driving gear drives the small planetary gears; the large planetary gears rotating simultaneously with the small ones and traveling around the stationary sun gear force the propeller shaft to revolve in the same direction as the crankshaft does.

CRANKSHAFT AND PISTON ROD ASSEMBLY.

The crankshaft and piston rod assembly consists of the master connecting rod and eight articulated rods.

The rods are of I-section. The big end of the master rod is fitted with a steel bearing (insert), the operating surface of which is covered with lead-bronze, and two flanges with eight holes for the articulated rod pins. Bronze bushings are pressed in the master rod piston head and all the heads of the articulated rods. The articulated rods are attached to the master rod by means of steel knuckle pins held in the master rod webs by plates preventing the pins from turning and axial movement.

SECRET

25X1

VALVE TIMING.

25X1

The valves are timed by means of the cam disc provided with two tracks; each track is fitted with four cams; the cams of one of the tracks control the intake valves operation, whereas those of the other one - the exhaust valve operation. The cam disc is driven from the crankshaft by means of the driving gear and the intermediate gear train with cylindrical gears; the cam disc through valve tappets push rods, and rocker arms actuates the valves.

The exhaust and intake valves are located in the cylinder head at an angle of 75 deg. to each other; they differ in the diameters of their stems and heads. Each valve is fitted with its own rocker arm and springs located in the rocker boxes which are closed with covers and fastened by hold-down cables.

The valve rocker arms are supported by needle bearings, the axles of which are installed in the rocker boxes lugs and tightened by a nut.

The cams of the cam disc provide required valve timing by means of the valve tappets, push rods, rocker arms and valves for the hot engine with the clearances specified for the cold engine. The valve timing is assured when assembling the engine according to the timing marks, thus it is unnecessary to adjust the valve timing. The engine is equipped with a centrifugal, driven uncontrollable supercharger. The impeller is driven by the rear cover driving shaft through the gear train which consists of four cylindrical gears, including one elastic gear.

The mixture is prepared in the K14-A carburetor. Fuel is delivered to the carburetor by the 702M fuel pump installed on the rear cover.

SECRET

25X1

LUBRICATING THE ENGINE

All the engine working surfaces are lubricated under pressure. The gear pump forces the oil from the tank to the hollow vertical shaft of the rear cover from where oil is supplied to the accessories and supercharger drive, then through the horizontal shaft to the crankshaft and propeller shaft passages, then to the piston rods, valve timing mechanism, reduction gear parts and variable pitch propeller. The heads of the articulated rods are lubricated under pressure. The piston rod heads, gudgeon pins and all the gears are splash-lubricated.

The valve mechanism and rocker arms are lubricated with consistent grease ("КУТУМ" - lubricant)

The oil circulated through the engine accumulates in the oil sump. The oil in sump is returned to the tank by the scavenge pump. The oil is filtered through two gauze filters located at the engine oil inlet and outlet. The filters can be easily removed for inspection and cleaning.

The engine inner cavity communicates with the atmosphere by means of two breathers; one of them is located on the crankcase nose section, the other - on the mixture chamber.

IGNITION.

The charge is ignited in the engine cylinders by means of two М-9° magnetos installed on the rear cover, and two СД-49С or СД-49СМ sparking plugs screwed in each cylinder. Besides the magnetos and spark plugs, the ignition system includes screened H.T. cables.

SECRET

25X1

25X1

STARTING THE ENGINE.

The engine is started by compressed air from the air bottle through the air distributor mounted on the rear cover and equipped with steel pipes which supply compressed air to the starting valves located on each cylinder head.

To facilitate the engine starting the gasoline is primed by means of the fuel primer into the mixture chamber through the priming pipe connection.

ENGINE PRINCIPAL DATA.

1. Model.	АИ-14Р
2. Engine cooling.	Air
3. Number of cylinders.	9
4. Cylinders arrangement	radial, one-row.
5. Numbering of cylinders	counterclockwise as viewed from the anti-prop side and considering the top cylinder as the first one. The master rod is located in the cylinder No.4.
6. Bore, mm	105
7. Piston stroke, mm:	
a) cylinder No.4	130
b) cylinders Nos.3 and 5	130.15
c) cylinders Nos.2 and 6	130.23
d) cylinders Nos.1 and 7	131.25
e) cylinders Nos.8 and 9	130.39

SECRET

25X1

SECRET

8. Total capacity, litres	[redacted] 25X1
9. Compression ratio	
10. Direction of rotation (as viewed from the anti-prop side):	25X1
a) crankshaft	L.H.
b) propeller	L.H.
11. Reduction gearbox type and drive ratio	planetary with three planetary gears, 0.787.
12. Propeller model	B-530-Д35 variable pitch propeller.
13. Supercharger type and drive ratio	centrifugal, uncontrolled, 7.105.
14. The engine is not designed for high altitude operation.	
15. Take-off rating:	
a) power, h.p.	260-2%
b) R.P.M.	2350+1%
c) suction excessive pressure, mm Hg.	35±10(throttle fully opened).
d) specific fuel consumption, gr/h.p.-hr.	255-280
16. Normal rating:	
a) power, h.p.	220-2%
b) R.P.M.	2050±1%
c) suction excessive pressure, mm Hg.	30±10%(throttle fully opened).
d) specific fuel consumption, gr/h.p.-hr.	240-255
17. Cruising rating:	
I. 75% normal power:	
a) power, h.p.	165
b) R.P.M.	1860+1%

SECRET

[redacted] 25X1

SECRET

c) suction pressure, mm Hg	680±15
specific fuel consumption, gr/h.p. - hr	210-225
II. 60% normal power:	
a) power, h.p.	132
b) R.P.M.	1730±1%
c) specific fuel consumption, gr/h.p. -hr.	205-225
d) suction pressure, mm Hg	630±15
18. Max. premissible r.p.m.	2450
19. Min. r.p.m. (low speed)	not above 500
20. Acceleration (time required to increase low speed r.p.m. up to take-off rating r.p.m.) seconds	2 - 3
21. Permissible time of continuous operation.	
a) at take-off rating	5 minutes
b) at normal rating	no limits
c) at max. permissible r.p.m.	3 minutes
22. Fuel grade	Aviation gazoline grade B-70
23. Octane number	not inferior to 70 octane
24. Carburetor model and quantity	K-14A without float, one
25. Carburetor inlet fuel pressure, kg/cm2	
a) at normal rating	0.2-0.5
b) at min.r.p.m.	not below 0.15
26. Fuel pump:	
a) model	702M, rotary
b) quantity	1
c) drive ratio	1.125
d) drive direction of rotation	R.H.
27. Oil grade for summer or winter operation	MK-22 or MC-20

SECRET

25.	Oil consumption at 75% normal power rating, gr/h.p.-hr.	not above 12
26.	Oil pump:	
	a) type	gear pump
	b) quantity	1, with scavenge and pressure pump sections.
	c) gravi ratio	1.125
	d) drive direction of rotation	L.H.
30.	Oil pressure in main pipeline (as measured in oil pump pipe connection), kg/cm^2	
	a) at operating ratings	4–6
	b) at low speed rating	not below 1.5
31.	Oil inlet temperature °C	
	a) recommended	50–65
	b) min. permissible	30
	c) max. at engine continuous operation	not above 75
	d) max. permissible during not more than 15 minutes	not above 85
32.	Max. permissible oil outlet temperature °C	125
33.	Max. difference between inlet and outlet oil temperatures °C	50
34.	Oil rate of flow at normal rating with an oil inlet temperature of 50–65°C, kg/min.	2.9–6.5
35.	Oil heating kg-cal/min:	
	a) at take-off rating	not above 110
	b) at normal rating	not above 95
36.	Cylinder head temperature, °C:	
	a) recommended	180–210
	b) max. permissible	120
	c) max. at engine continuous operation	not above 230

25X1

25X1

[redacted] 25X1

	d) max. permissible at take-off and climb rating during not more than 15 minutes of continuous operation	not above 240
	e) max. permissible at climb rating during not more than 5 minutes of continuous operation	not above 250
37.	Magnetos:	
	a) type	four-spark, shielded
	b) quantity	2
	c) drive ratio	1.125
	d) drive direction of rotation	L.H.
38.	Spark plugs:	
	a) model	CД49CM or CД-49C ceramic
	b) quantity per cylinder	2
39.	Firing order	1-3-5-7-9-2-4-6-8
40.	Max. permissible drop of crankshaft r.p.m. when operating the engine with one magneto at normal and cruising (0.75 normal power) ratings and the propeller set in low pitch position	60
41.	Valve timing, in degrees of crankshaft rotation(cylinder No.4):	
	a) Intake valve opening before TDC	20±4
	b) intake valve closing after BDC	54±4
	c) exhaust valve opening before BDC	65±4
	d) exhaust valve closing after TDC	25±4
42.	Intake and exhaust valves clearances for cold engine adjusting, mm:	
	a) for valve timing checking	1.1
	b) specified for engine operation	0.3-0.4

[redacted] 25X1

SECRET

43.	Spark advance in degrees of crankshaft rotation (for R.H. [redacted] magnetos)	30±2°
44.	Engine starting	by compressed air 25X1
45.	Constant speed governor:	
	a) model	P-2, centrifugal
	b) drive ratio	1.045 25X1
	c) drive direction of rotation	R.H.
46.	Air compressor:	
	a) model	AK-50M, piston
	b) drive ratio	0.9
	c) drive direction of rotation	R.H.
47.	Vacuum pump:	
	a) model	AK-4C, rotary
	b) drive ratio	0.9
	c) drive direction of rotation	R.H.
48.	Generator	
	a) model	ГСК-1500
	b) drive ratio	2.5
	c) drive direction of rotation	L.H.
49.	Tachometer generator drive:	
	a) drive ratio	0.5
	b) drive direction of rotation	L.H.
50.	Engine dry weight, kg.	195+2%
51.	Engine oil weight after control test, kg.	2.5
52.	Engine dimensions, mm.	
	a) diameter	985±3
	b) length	956±3
53.	Compressed air distributor adjustment	- with cylinder No.4 in position 8° after TDC during expansion stroke the slide valve opening must open compressed - -air-to-No.4 cylinder supply opening up to 1mm approximately (in the direction of slide valve rotation).

SECRET

[redacted] 25X1

[redacted] 25X1

SECRET

3. B-530 Д-35 VARIABLE PITCH PROPELLER.

[redacted] 25X1

B-530 Д-35 propeller is automatically controlled. The automatically controlled propeller utilizes the hydraulic-centrifugal principle of operation. The propeller in conjunction with P-2 constant speed governor automatically maintains engine r.p.m. at all engine ratings. Oil flows from the governor pump to the propeller cylinder and builds up pressure which moves the blades to a low pitch.

Blades are moved to a high pitch by the action of centrifugal force on the counterweights.

During propeller operation counterweights turn the blades toward high pitch at all engine ratings.

When the oil system malfunctions the oil pressure in the propeller system is low, the propeller blades move toward high pitch giving the possibility to continue flying.

PROPELLER PRINCIPAL DATA:

1.	Propeller type	tractor, automatic, variable pitch	
2.	Direction of rotation	L.H.	
3.	Diameter	2.4m.	
4.	Number of blades	2	
5.	Blade configuration	oar-shaped	
6.	Max. blade width	240	
7.	Min. blade setting angle at R=1,000 mm.	12°	
8.	Designed propeller inertia moment	0.5 kg.cm sec^2	
9.	Max. blade setting angle at R=1,000 mm	28°30	+1°
10.	Blade pitch range	16°30	+1°

SECRET

[redacted] 25X1

[redacted] 25X1

SECRET

11.	Principle of operation	hydraulic-centrifugal
12.	Operation scheme	direct
[redacted]	speed governor	P-2 25X1
14.	Counterweight setting angle	25°
15.	Propeller weight with parts not included in the assembled propeller.	39 kg.

PROPELLER DESIGN.

The propeller hub is made as a single-piece unit. Its main part is a cylinder with two blade barrels. The hub front part is fitted with the cylinder attachment lugs.

The hub rear face is fitted with a flange, to which the propeller boss is attached.

The boss inner surface is provided with splines and seats for the front and rear cones which serve for mounting and centering the propeller on the engine shaft.

On the boss is a carrier sliding along the boss. The carrier is provided with grooves for sliding blocks mounted on pins of the blade shanks.

To reduce friction a textolite insert is pressed in the carrier. The carrier turning is prevented by two keys sliding along the boss splines.

Located in the blade barrel is the blade shank which rests by its lower fillet on the rollers placed in the retainer.

The rollers, in their turn are supported by the ring located on the hub fillet. So, the thrust bearing is formed.

On the top of the shank fillet is the same retainer with rollers secured by the hub nut. Thus the thrust bearing is formed which takes the centrifugal force of the blade.

The hub nut is fitted with a pressed-in textolite insert forming the bearing which takes radial loads.

The blade shank and hub nut fillets contacting with the rollers are cemented.

SECRET

[redacted] 25X1

The blade barrel thrust bearings are tightened by the [redacted] torque is measured.

To prevent lubricant from getting out of the hub a collar is installed in the hub nut assembly. The collar is located in the groove formed by the textolite insert end face and the ring end face of the nut screwed in the hub nut.

Counterweight plates are attached to the nut end face by screws to compensate the static unbalance of the assembled propeller.

The hub nut is locked by a lock plate screwed to the hub. The blade shanks lower end faces are fitted with excentrically spaced pins made integral with the shanks. The bronze sliding blocks mounted on these pins enter the corresponding grooves in the carrier.

Thus, the carrier sliding along propeller boss turns both blade shanks and the blades.

BLADES.

The propeller blades are of oar shape. The blade is made from pine planks glued lap with delta-wood planks forming the blade root.

The blade root is taper threaded and fitted with a metal shank screwed over it. The shank is screwed over the blade root with a special sealing cement. The shank outer surface has two centering collars and thread for attaching the blade in the propeller hub barrel.

Stiffness of the blade is increased by gluing it with two laminations of birch plywood.

A rubber ring is used to provide blade-to-barrel joint tightness. To prevent the oil from getting to the blade shank end a rubber gasket is placed under the end washer.

The blade leading edge is reinforced by a metal tipping.

There are two marks on the blade for setting the blade in the hub at a desired angle.

[redacted]

[redacted] 25X1

SECRET

When screwing in the blade, the blade axial mark should [redacted] with the center division of the setting scale on the barrel and the mark perpendicular to the axial one - 25X1 - with the barrel fillet edge.

COUNTERWEIGHT ASSEMBLY.

The counterweight assembly consists of a counterweight whose bracket is made integral with a clamp, clamp bolt, weight, balance washers and a bolt attaching the weight and the bracket washers.

The counterweight is placed on the blade shank and clamping it secures the blade in the barrel.

The angular position of the counterweight is determined by aligning its mark with the center mark of the scale on the barrel end.

CYLINDER ASSEMBLY.

The main parts of the assembly are a cylinder and a piston.

One of the cylinder ends has fittings for its attachment to the hub, and the other end has a shank with a hole for a handle to turn the cylinder in the hub lock when mounting it).

This shank is used also for attachning a cover.

The piston movement to the left (to high pitch position) is restricted by stopping the restricting ring against the cylinder bottom.

The cylinder assembly is sealed with collars.

SECRET

[redacted] 25X1

25X1

[redacted]

PROPELLER OPERATION.

SECRET

Operation of the propeller in conjunction with the [redacted]t speed governor provides engine constant r.p.m. 25X1 when flight conditions are changed.

The engine r.p.m. is regulated by the governor spring tension.

Centrifugal forces on the counterweights at desired r.p.m. lift the slide valve, which cuts off oil supply to the propeller cylinder and the centrifugal forces on the counterweights balance the spring tension. Any change in the desired r.p.m. causes the slide valve movement, because the centrifugal forces on the fly weights and the spring tension become unbalanced.

When the desired r.p.m. decrease the force generated by the fly-weights becomes less than the spring tension and the spring pushes governor slide valve down. The oil from the governor pump begins flowing into the propeller cylinder and actuating the piston moves the blades to the lower pitch angle, and permits the engine to increase its r.p.m. to the desired valve.

The flyweights lift the slide valve which cuts off oil supply to the propeller cylinder.

Further lowering of the pitch is ceased and the engine will hold its r.p.m. at the desired value.

SECRET

[redacted]

25X1

SECRET

[redacted]

25X1

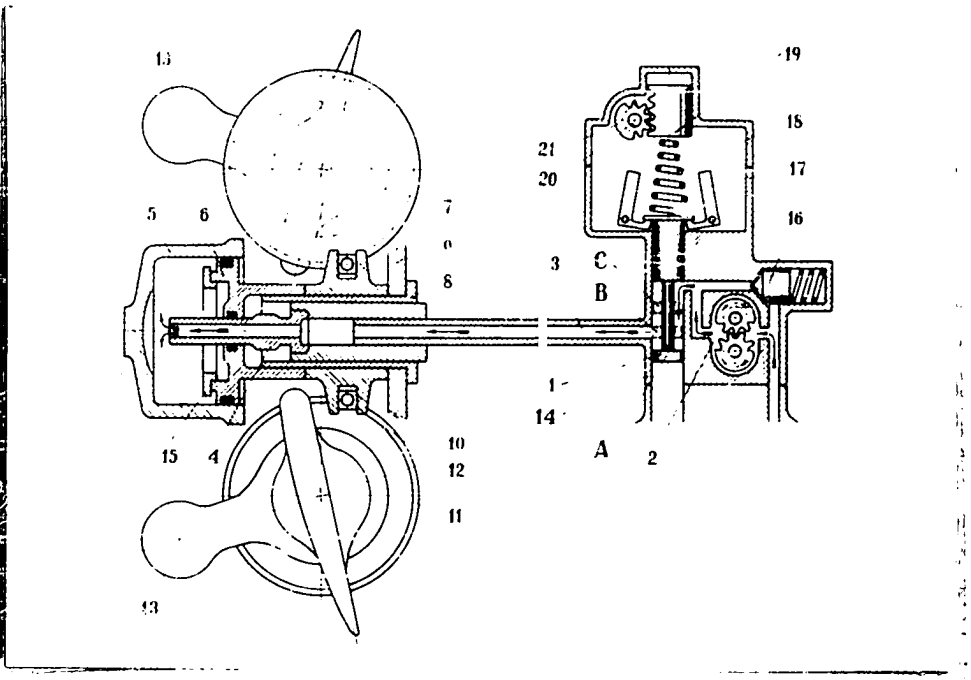


Fig. 21-A. Propeller and P-2 governor operating diagram when propeller high pitch is changed to low pitch.

A - Slide valve position when propeller high pitch is changed to low pitch (underspeed).

B - Slide valve position when engine r.p.m. are constant (onspeed).

C - Slide valve position when propeller low pitch is changed to high pitch (overspeed).

SECRET

[redacted]

25X1

25X1

SECRET

1) Slide valves; 2) governor oil pump; 3) oil passage; 4) connection; 5) propeller cylinder; 6) propeller piston; 7) carrier; 8) propeller boss; 9) propeller hub; 10) slid-

25X1

block; 11) blade shank; 12) pin; 13) counterweights; 14) crankcase front section; 15) restricting ring; 16) pressure relief valve; 17) flyweight; 18) spring; 19) rock; 20) manual control shaft; 21) control shaft gear.

With the increase in engine speed there is an increase in the flyweight centrifugal force which lifts the slide valve against tension of the spring.

The slide valve cuts off the governor pump from the propeller cylinder and permits the oil from the propeller cylinder to drain into the engine crankcase.

The counterweights move the propeller blades to a higher pitch angle and the oil flows freely from the propeller cylinder through the governor into the crankcase. The engine r.p.m. will decrease and at the desired r.p.m. the slide valve cuts off the oil supply to the propeller cylinder.

Oil stops flowing from the cylinder and the pitch angle will not increase any more.

Thus, any change in the engine r.p.m. from the desired value causes the blades movement.

With the increase in engine speed the blades move to a high pitch, with the decrease in engine r.p.m. to a low pitch.

In flight the pilot can change the engine r.p.m. The pilot can change the spring compression by operating the gear and rack through control cables.

The desired r.p.m. depend on the spring tension.

SECRET

25X1

[redacted] 25X1

SECRET

4. ENGINE MOUNT.

[redacted]АИ-14P engine is attached to the mount by eight studs fitted with rubber shock mounts. The engine mount consists of the ring and supporting struts made of steel tubing. Welded to the ring are eight fittings for the attachment of the supporting struts, eight welded boxes for the rubber shock mounts and engine attachment studs. 25X1

The supporting struts are welded in pairs to the mount-to- fuselage attachment yokes. The struts-to-ring attachment yokes are welded to the opposite ends of the struts.

The engine mount is attached to the fuselage by four steel bolts.

5. ENGINE COWLING AND SHUTTERS.

The engine installed on the aircraft is equipped with a removable cowling. The cowling consists of the top and bottom cowl panels connected by latches.

The top cowl panel is hinged to the firewall, the bottom cowl panel is fastened by means of its brackets to the attachments welded on the fuselage frame 0.

The top cowl panel is fixed in opened position by a tubular knuckle strut / installed on the left/, the bottom cowl panel opening is limited by the cable.

The panels are made of duralumin sheets reinforced with longitudinal and lateral stiffeners; the front portions of both panels are riveted to the duralumin tube bent at an inner diameter of 746 mm.

Steel boxes and latch bases are attached to the ends of the lateral stiffeners. Carburetor air intake cover with the ram air intake opening for the dust filter is riveted to the bottom panel; the access door

SECRET

[redacted] 25X1

[redacted] 25X1

[redacted] 25X1

to the oil tank filler cap is installed on the cowl top panel. The cowling air entry is closed by means of controllable shutters which provide engine cooling.

The shutters consist of the inner stationary disc, moving disc, flaps and outer ring machined from a stamped duralumin angle.

The stationary fixed disc is attached to the engine reduction gear case with 4 studs, the outer ring - to the engine cylinder studs by eleven supporting struts.

The moving disc is mounted on the stationary one and rotates on three ball bearings along the guide rails riveted to the stationary disc.

Installed on the moving disc is the bracket to which the shutters control rod is connected.

The shutter flaps are made of duralumin sheets. The shutters turn about the steel axles which are attached to the moving and atationary discs.

The bell cranks with oval slots are riveted to the flaps; the bolt mounted on the moving disc comes through the slot of each bell crank.

When the moving disc turns the bolts turn the bell cranks and shutters flaps. The rotation of the moving disc and the opening of the shutters flaps is limited by the stop on the stationary disc. The shutters are controlled by the actuating screw by means of a rod. Control lever is located on the right control board in the front cabin.

For intense cooling of the cylinder heads the engine is equipped with the deflector made of duralumin sheets and located in the plane of cylinder axes.

The guide vane is riveted to the upper part of the shutters outer ring to provide better cooling of the upper engine cylinders. On the left the shutters flaps have a cut-out for the blast tube intake of the generator mounted on the engine.

[redacted] 25X1

[redacted] 25X1

SECRET

6. ENGINE STARTING AND PRIMING SYSTEMS.

[redacted] art the engine by compressed air from the aircraft 25X1
[redacted] tem by means of the starting button.

Switch on the ЭК-48 solenoid-controlled pneumatic valve and the КП-4716 booster coil by pushing the starting button.

The compressed air enters the engine cylinders through the valve and air distributor mounted on the engine.

Simultaneously the H.T. current is supplied from the booster coil to the engine spark plugs.

Before starting the engine fill the main fuel feed line by operating the PHA-1A hand pump and prime the engine cylinders using the primer.

The primer is installed on the right control board in the front cabin, the PHA-1A hand pump is attached to the right lower longeron.

Should the engine fuel pump fail to operate the hand pump may be used as an emergency fuel supply pump.

The engine lubricating system is provided with an oil dilution system for better starting the engine at low temperatures.

The oil is diluted by gasoline. The gasoline is delivered from the engine fuel pump through the oil delution valve to the engine oil inlet pipe connection, welded to the adapter. The oil delution valve is controlled by the push switch on the right instrument panel in the front cabin.

7. CARBURETOR AIR INTAKE AND EXHAUST MANIFOLD.

The air enters the carburetor through the air intake. The carburetor air intake consists of the dust gauze-filter, duct and air intake bellmouths. Inside the duct there is a controllable shutter, regulating the cold and hot air flow.

SECRET

[redacted] 25X1

The dust filter and intake pipes are attached by means of hinges made of sheet duralumin.

The air thermometer bulb flange is riveted to the right [redacted] of the intake duct.

[redacted]he air intake is located between the fifth and sixth engine cylinders and attached by four studs to the carburetor flange. The hot air heated when passing around the finned cylinders, enters the carburetor (through the intake bell-mouths).

In this case the shutter closes air passage from the dust filter. When the air passes through the dust filter, the hot air through the intake bellmouths is not admitted.

The air intake control is mounted on the left control board in the front cabin. The exhaust manifold consists of two separate parts, tapping the exhaust gases under the aircraft.

The right manifold part serves for tapping exhaust gas from five, and the left - from four cylinders.

Each part of the manifold is divided into sections made of sheet steel .

The manifold sections are joined by clamps with metal-asbestos gaskets. The manifolds are attached to the engine by the nipples, welded to the pipes, coupling nuts and elastic sealing rings.

8. ENGINE CONTROL.

The engine controls (Fig.22) include the throttle control, mixture control, propeller pitch control and controls of the shut-off valve, carburetor air intake, cowl shutters and oil cooler shutter.

25X1

SECRET

25X1

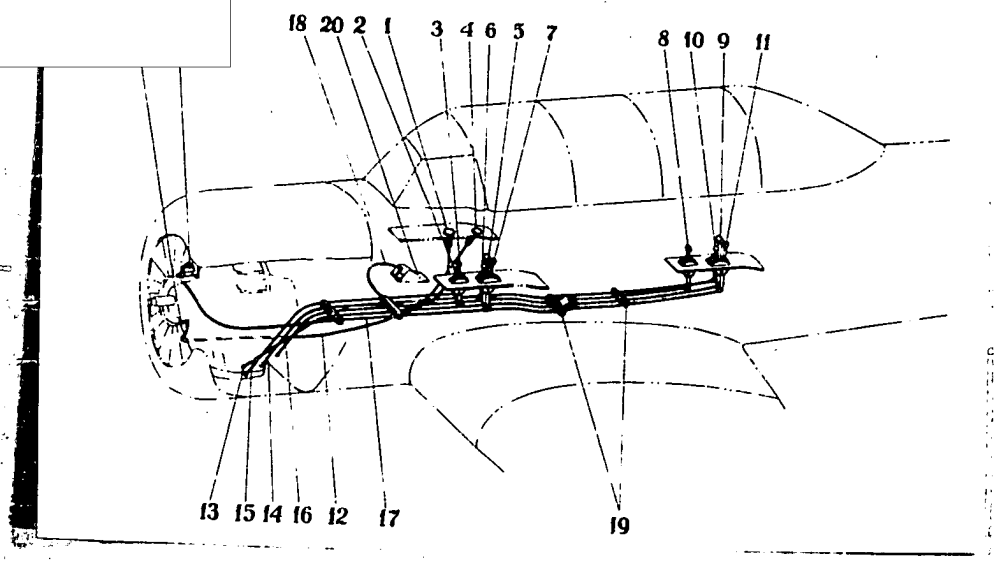


Fig. 22. Engine control system.

1) Oil cooler shutter control lever; 2) air intake shutter control lever; 3 and 8) shut-off valve control lever in the front and rear cabins; 4) cowl shutters control lever; 5 and 9) throttle valve lever in the front and rear cabins; 6 and 10) mixture control lever in the front and rear cabins; 7 and 11) propeller pitch control lever in the front and rear cabins; 12) cowl shutters control cable; 13) throttle control cable; 14) mixture control cable; 15) air intake shutter cable; 16) shut-off valve control cable; 17) propeller pitch control cable; 18) oil cooler shutter control cable; 19) cable casing attachment blocks; 20) oil cooler duct shutter; 21) cowl shutters control cable bracket; 22) constant speed governor.

SECRET

25X1

The throttle control, mixture control, shut off valve and propeller pitch are controlled by the levers located on the left control board in the front and rear cabins.

The carburetor air intake control lever is installed only in the front cabin.

The cowl shutters and oil cooler shutters controls are mounted on the right control board in the front cabin.

The engine accessories are controlled through steel cables. The cables run in copper guide tubes. The cables are joined with control levers and accessories by means of the ball joints and forks. The cable tubes run through the faidleads mounted on the brackets to the airframe.

9. FUEL SUPPLY SYSTEM.

The aircraft fuel system (Fig.23) consists of the two tanks with total capacity of 122 litres, filters, 702M fuel pump, K-14A carburetor, shut-off valve, PHA-1A hand fuel pump, CB3C-1377 fuel contents gauge, primer and fuel pipe line, made of aluminium-magnesium tubing and braided hoses.

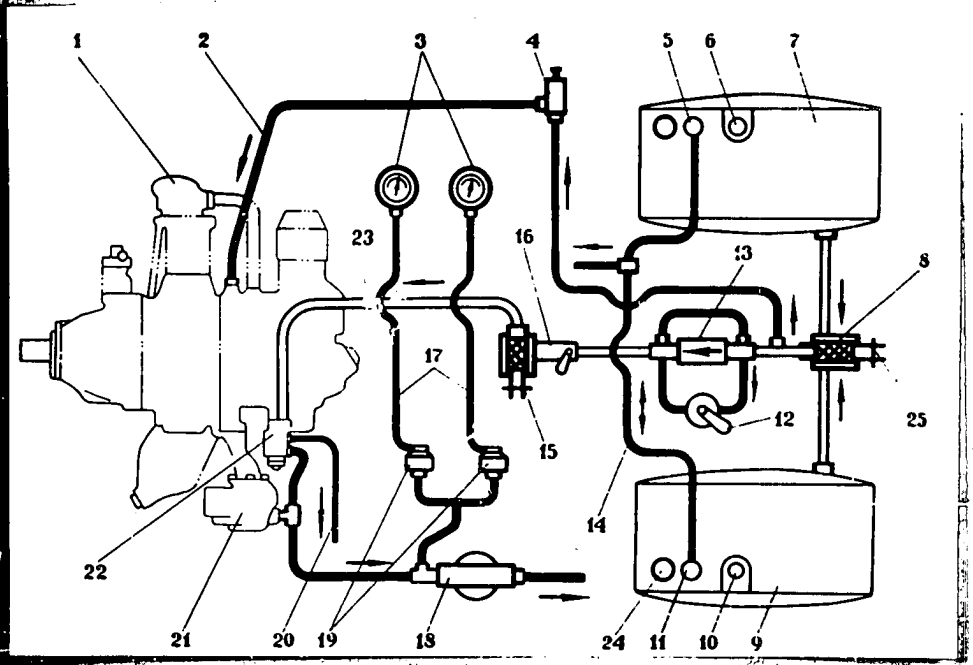


Fig. 23. Fuel system.

1) Engine; 2) priming pipe line; 3) fuel pressure gauges; 4) primer; 5 and 11) fuel tanks vent pipe connection; 6 and 10) fuel contents gauge transmitters; 7 and 9) fuel tanks; 8) filter-sump; 12) PKA-1A hand pump; 13) non-return [illegible] 14) tanks vent line; 15) strainer; 16) shut-off valve; 17) electric cables; 18) oil delution valve ; 19) fuel pressure transmitter; 20) 702 fuel pump vent line; 21) carburetor; 22) 702M fuel pump; 23) hose; 24) filler neck; 25) filter-sump drain plug.

The tanks are suspended in the wing centre section between ribs 1 and 3, on the duralumin straps, held together by turnbuckles. The tanks are welded of sheet aluminium-manganese alloy.

The tank consists of a shroud and two sides. The two buffles with lightening holes are installed for rigidity inside the tanks.

The tanks are provided with vent lines.

The electrical fuel contents gauge transmitters are fitted to the flanges welded to the tanks. The fuel contents gauge and fuel reserve warning light are installed on the instrument panel in the front cabin.

The fuel is delivered from the both tanks by the pipes to the filter-sump fitted on the rear spar of the wing centre section. Then the fuel from the shut-off valve passes the filter. When operating the hand pump the suction of fuel from the main system is prevented by the non-return valve with the breather-pipe. The hand pump is used for filling the fuel pipe lines and carburetor with fuel before starting the engine.

The pump is located on the lower longeron of the right side frame panel between frames 2 and 3, and connected by means of a steel rod to the operating lever, installed on the right board in the rear cabin.

The fuel pressure is checked by the ЭМИ-3К electrical three pointer engine gauge. The ЭМИ-3К gauge is a combination instrument measuring the fuel pressure, oil pressure and oil temperature. The instrument set includes the УКЗ-1 indicator, П-15 fuel pressure transmitter П-15М oil pressure transmitter and П-1 oil thermometer resistance bulb.

25X1

SECRET

The electrical engine gauge indicators are mounted on the instrument panels in the front and rear cabins.

The fuel pressure transmitters are attached to the

ll.

25X1

The pipe line supplying the fuel to the transmitters is made of aluminium-magnesium tubing and connected to the tee of the 772 cock.

The ЭМИ-3К transmitters are connected to the indicators with electrical wiring. The transmitters wiring are sealed in the firewall holes by the rubber gaskets. The pipe lines have nipple connections. The pipe lines, fuel tanks and hoses are painted yellow. The fuel pipe lines are attached by the blocks and clips. The pipe lines subjected to severe vibration are built up from separate pipes, connected by hoses.

10. OIL SYSTEM.

The aircraft oil system consists of the oil tank with an operating capacity of 17 litres, oil filter with pocket, oil pump, 1172 oil cooler and oil pipe line made of braided hoses. With the engine running, the oil is delivered from the tank through the hose to the oil pocket, filter and then enters the engine. The oil accumulated in the engine sump, is scavenged by the pump and returned to the tank through the oil cooler.

The oil tank is welded from sheet aluminium-manganese alloy. The tank consists of a shroud and two sides. The hopper and foam tray are installed inside the oil tank.

SECRET

25X1

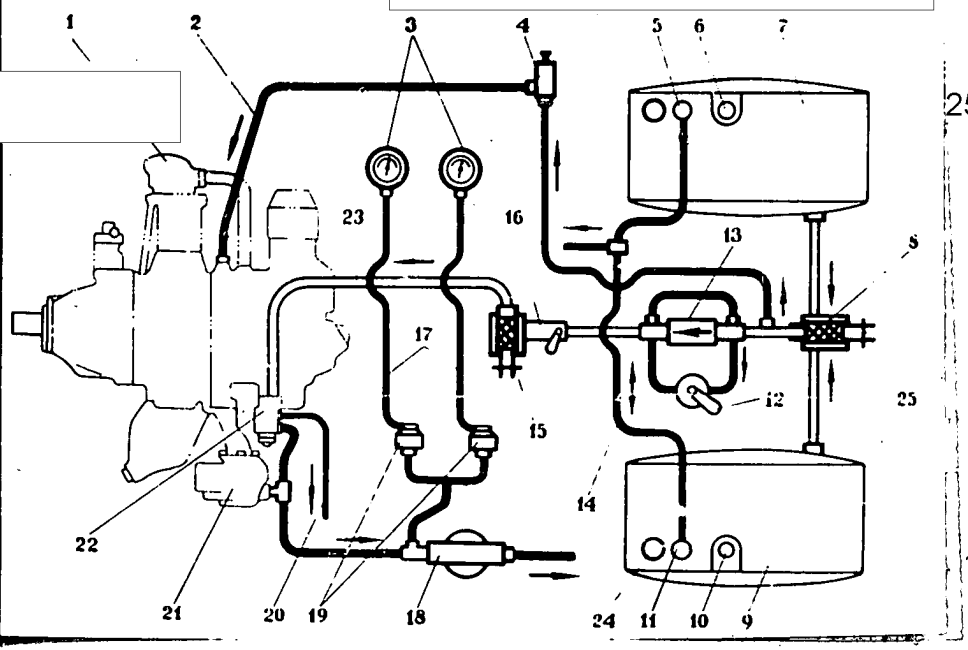


Fig. 24. Oil system.

1) Engine; 2) fuel supply pipe line from the oil delution valve; 3) oil pressure and temperature gauges; 4) electric cables; 5) oil tank; 6) tank filler neck; 7) tank vent line; 8 and 8) flexible pipe lines; 9) oil cooler; 10) oil cooler drain plug; 11) oil thermometer bulbs; 12) filter; 13) oil pressure - transmitter; 15) oil filter drain plug.

The tank filler neck is closed by the cap, fitted with bayonet gauge measuring the oil contents (in litres) in the tank.

The oil tank is drained through the pipe welded to the tank. The oil tank is fastened by duralumin straps with rubber gaskets in special supports riveted to the firewall.

The engine oil inlet pressure and temperature are checked by the electrical engine gauge (see section "Fuel system").

25X1

SECRET

The oil thermometer bulbs are installed in the oil pocket. The oil is cooled by the oil cooler. The oil cooler outlet duct is equipped with a controllable shutter. The r is controlled from the right control board in the front cabin. The shutters are controlled through a cable. The oil cooler is installed on the right side in the wing centre section nose box.

25X1

SECRET

25X1

SECRET

VI. AIRCRAFT SPECI

aircraft equipment includes the cabin equipment, navigational, radio and electrical equipment and engine instruments. The arrangement of the aircraft special equipment is shown in Fig.25.

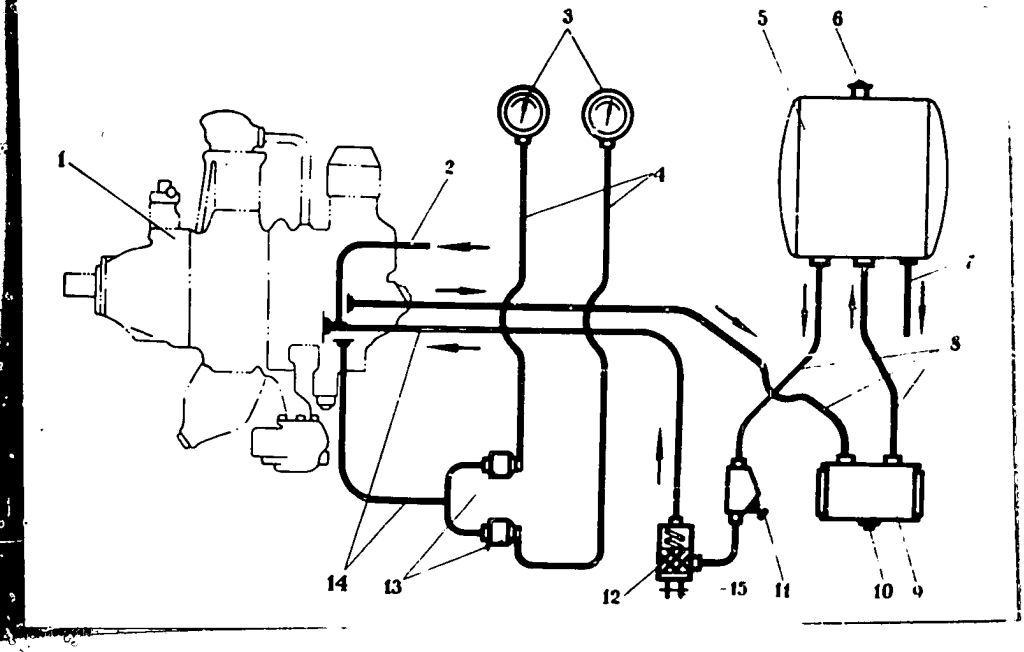


Fig. 25. The arrangement of the aircraft equipment main units.

1) СФ-3000Р filter; 2) КП-4716 booster coil; 3) circuit breakers panel; 4) Р-800 radio control unit; 5) АРК-5 A.D.F. control panel (in front cabin); 6) ПАГ-1ФП inverter; 7) АРК-5 A.D.F. control panel (in rear cabin); 8) Р-800 radio set transmitter ("А" unit); 9) АРК-5 A.D.F. relay junction box; 10) АРК-5 automatic direction finder; 11) rectifier ("В" unit); 12) Р-800 radio set receiver ("Б" unit); 13) common stub antenna; 14) АРК-5 A.D.F. loop unit; 15) ГСК-1500 generator; 16) РК-1500Р generator control box; 17) ПО-250 inverter; 18) 12А-10 aircraft storage battery; 19) ТЭ-204 tachometer generator; 20) power supply control panel; 21) ФР-100 taxiing light; 22) ФС-155

landing light; 23) ПВД -954 pitot static tube; 24) front cabin instrument panel; 25) rear cabin instrument panel; [illegible] ШРА -250ЛК ground supply plug connection; 27) 47Ж [illegible] cable lamp receptacle; 28) СПУ-2 interphone rectifier.

I. CABIN EQUIPMENT.

The cabin equipment consists of the instruments and controls conveniently located on the instrument panels and on the cabin sides.

The instrument board of the front cabin consists of three panels. The left and right panels are rigidly attached to the canopy on four rubber shock absorbers.

The left panel contains: landing and taxiing lights circuit breakers, elevator trim neutral position warning light, engine starting button, ПМ-1 ignition switch, L.G. control cock and L.G. position warning lights with the test button.

The right panel contains: rheostats for right and left U.V. lights, P-800 radio set control panel, compass light rheostat and oil delution valve push-switch.

The centre panel contains: АЧХО clock, УС-350 air speed indicator, АГИ-1 artificial horizon, ВР-1I rate-of-climb indicator, МВ-16 boost gauge, СБЭС-1377 fuel contents gauge, ВД-10 altimeter, ЭУП -53 electrical turn and bank indicator, A.D.F. СУП -7 indicator, ЭМИ-3К three-pointer engine gauge, 2М-80 air pressure gauge, ВА-1 voltammeter, ТУЭ-48 carburettor air inlet temperature gauge, ТЦТ-13 cylinder head temperature gauge, ТЭ-45 tachometer, emergency fuel reserve and generator failure warning lights.

Under the centre panel is the switch board with the generator and battery switches and twelve circuit breakers.

In the main the instrument board of the rear cabin is the same as that in the front cabin.

The left panel contains: left U.V. light rheostat, ПМ-1 ignition switch, L.G. control cock and L.G. position warning lights with the test button.

The right panel contains: right U.V. light rheostat, compass light rheostat, plates with the principal characteristics of the engine and aircraft and a plate "Caution".

The centre shock-mounted panel contains МВВ block, МС-350 air speed indicator, АГИ-1 artificial horizon, ВР-10 rate-of-climb indicator, ВР-10 altimeter, ЭУП-53 electrical turn and bank indicator, A.D.F. СУП-7 indicator, ЭГИ-3К three-pointer engine gauge, 2К-80 air pressure gauge light, emergency fuel reserve and generator failure warning lights, ignition switch and rear cabin turn and bank indicator switch.

The side control boards of the front and rear cabins are attached to the welded brackets, of the fuselage frame.

On the left control boards of both cabins are the following control levers: shut-off cock, mixture, throttle and propeller and flap control valves.

Besides that front cabin control board is equipped with the air heating control levers and air system charging valve.

The right control boards contain emergency L.G. control valves and СПУ-2 interphone control boxes.

Besides, the cowl shutter and oil cooler shutter controls and fuel priming pump are installed on the right control board of the front cabin, and the fuel hand pump lever - on the right control board of the rear cabin. The map case is on the control board side panel of the front cabin.

The A.D.F. control panels, ultraviolet and white lights are attached to the fuselage brackets on the starboard side of both cabins. On the port side are also installed the U.V. lights. The rear cabin is provided with oil and fuel system diagram-plates.

SECRET

On the left side of the cabin are the holders with compass and A.D.F. deviation cards and air speed indicator correction card. The first-aid kit is located on the [redacted] 25X1 right side of the rear cabin. On the starboard side of the rear cabin aft of the control board is a baggage hold.

The CПШ-2 flare pistol is attached to the front spar of the wing center section by means of the pistol holder and the flare stowage for nine flares is on the left middle opening panel of the front cabin.

Both cabins are provided with the KИ-12 compasses mounted on the right of the shrouds in both cabins above the instrument board.

The elevator trim control handwheels are installed in the port side of both cabins above the control boards.

The rear space vision mirror is mounted on the windscreen bowl in the front cabin to the right of the aircraft centre line.

Both cabins are provided with pilots seats with bottoms for parachutes and are equipped with pilot's safety belts.

On the backs of the seats are cushions. The front cabin seat is mounted on the steel welded shaft. The seat may be adjusted for height and fixed in three positions by means of the seat adjustment lever welded to the shaft.

The rear cabin seat is mounted on the brackets of the fuselage framework and also may be adjusted for height and fixed in three positions. The seat back of the rear cabin is equipped with the control device for the shoulder harness adjusting.

The cabins are provided with plenum ventilation.

There is a controllable shutter installed in the front cabin under the windscreen. When the shutter is opened, fresh air gets into the cabin. The ventilating duct with a scoop extended into the air stream is installed in the port side of the rear cabin.

SECRET

[redacted] 25X1

SECRET

2. NAVIGATIONAL EQUIPMENT.

[redacted] 25X1

[redacted] 25X1

The navigational equipment consists of АЧХО clock, [redacted]gnetic compass, АГИ-1 artificial horizon, ВД-10 altimeter, УС-350 air speed indicator, ЭУП-53 turn-and-bank indicator and ВР-10 rate-of-climb indicator.

The air pressure is supplied to the air speed indicators, rate-of-climb indicators in both cabins and to the ЭГИ-3К engine gauge transmitters from the ПВД-954 pitot static tube installed on the left wing. The tubing from ПВД-954 pitot static tube to instruments consists of a dynamic and static lines.

The line is provided with water traps for draining the condensate. The pitot static tube and clock are electrically heated.

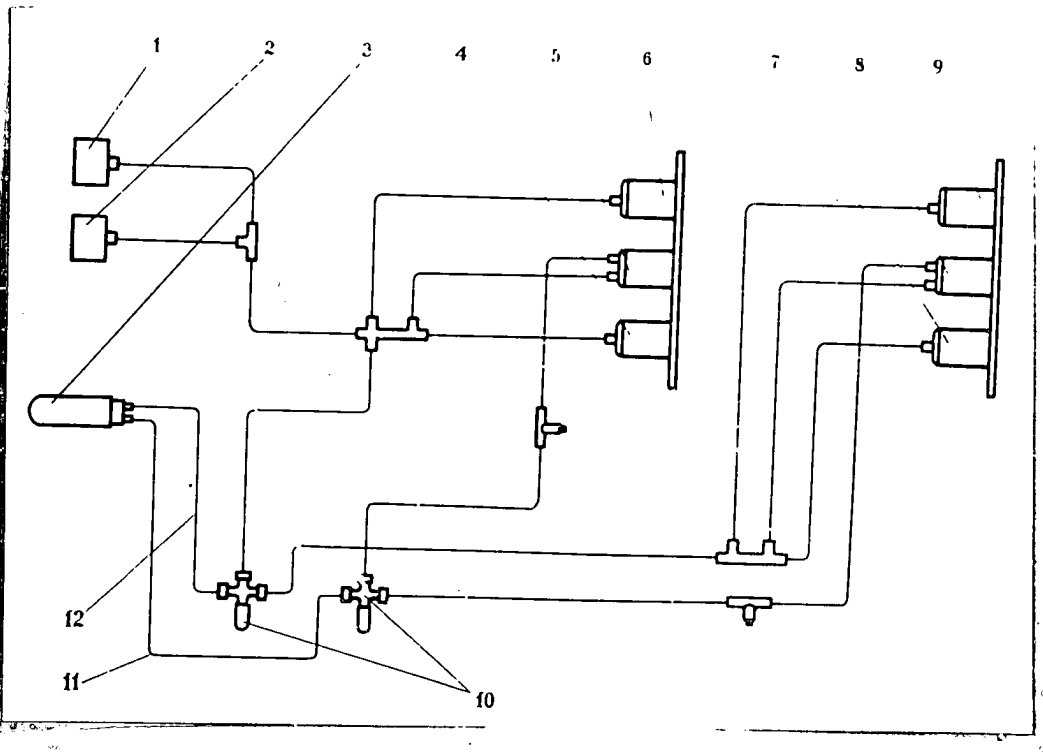


Fig. 26. Diagram of pitot static tube line.

SECRET

[redacted] 25X1

SECRET

1) and 2) Fuel pressure gauge transmitters; 3)ПВД-954 pitot tube; 4) and 7) ВД-10 altimeters; 5) and 8)УС-350 air-speed indicators; 6) and 9) ВР-10 rate-of-climb indicators; 10) water-traps; 11) dynamic line; 12) static line.

The artificial horizons are supplied from ПАГ-1ФП inverter installed on the airframe behind the front cabin seat.

3. RADIO EQUIPMENT.

The aircraft is equipped with the P-800 V.H.F. two-way communication radio set, АРК-5 automatic direction finder and СПУ-2 interphone system.

The P-800 radio set provides the communication with a ground station of РАС-УКВ type within the following distance ranges:

Altitude	Distance
1000 m	120 km
2000 m	160 km
5000 m	230 km

When communicating with other aircraft the distance range is more than 120 km at flight altitude exceeding 500 m.

SECRET

SECRET

25X1

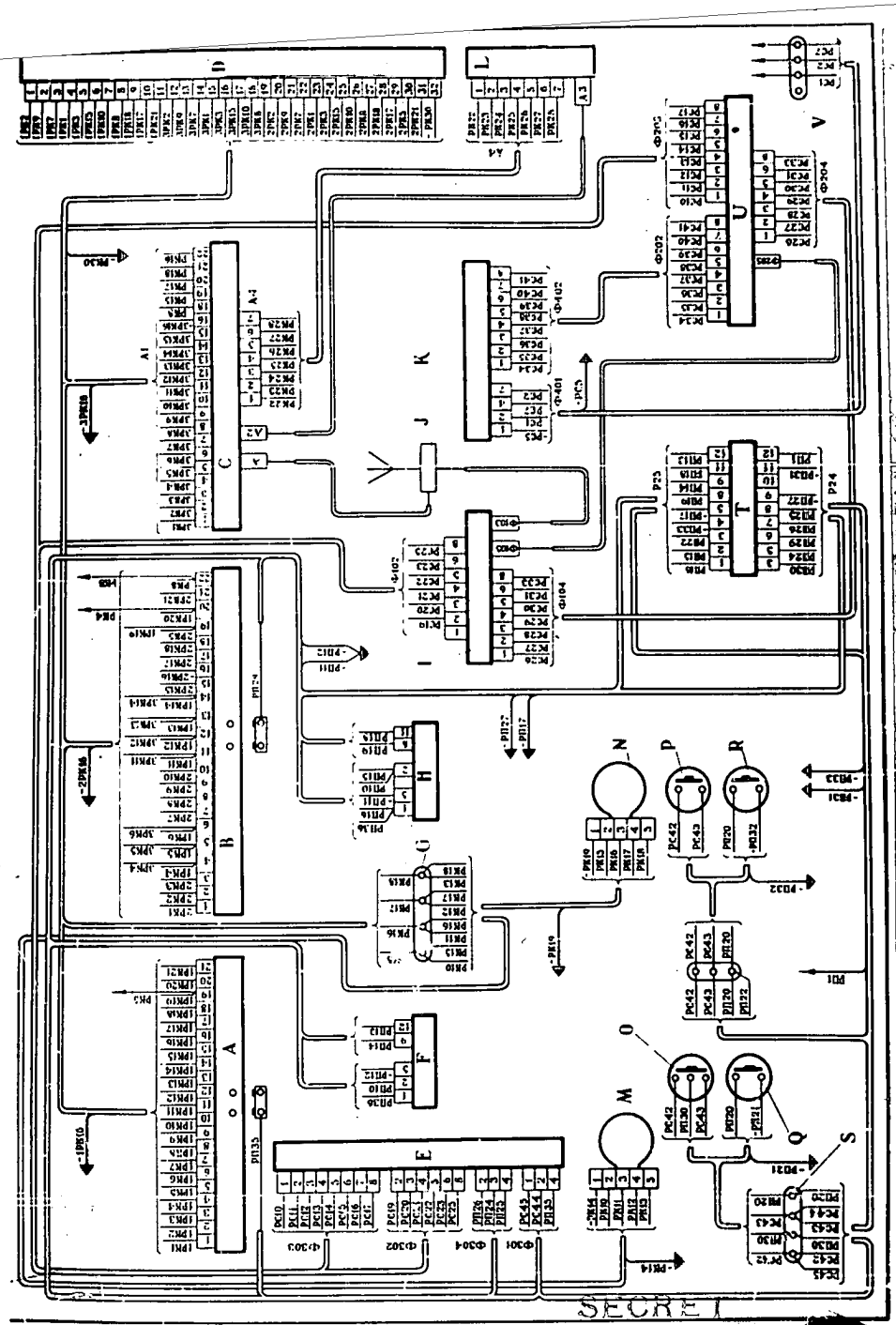


Fig. 27. Diagram of Radio Equipment.

25X1

A) APK-5 A.D.F. control panel, front cabin;
B) APK-5 A.D.F. control panel, rear cabin;
C) APK-5 A.D.F. receiver;
D) APK-5 relay-junction box; E) P-800 radio set control panel; F) interphone control box, front cabin; 75k terminal block; H) interphone control box, rear cabin; I) P-800 radio transmitter ("A" unit); J) АФ-1 antenna filter; K) rectifier ("B" unit; L) APK-5 loop unit; M) СУП-7 pilot's selsyn indicator; N) СУП-7 pilot's selsyn indicator; O) transmitter button (ПРД); P) transmitter button (ПРД); Q) interphone amplifier button; R) interphone amplifier button; S) 75K terminal block; T) interphone amplifier; U) P-800 radio receiver ("B" unit); V) 75K terminal block.

The radio set has a remote push-button control. The radio control unit is installed on the right instrument panel in the front cabin.

The receiver, transmitter and rectifier of the P-800 radio set and the СПУ -2 interphone amplifier are installed on a special panel between fuselage frames 4 and 5.

The APK-5 automatic direction finder operates within a wave band from 230 to 2000 m. at a distance range of 160 to 200 km (when communicating with 500 w ground beacons).

The APK-5 A.D.F. receiver and relay-junction box are installed on the panel under the canopy rear window.

The A.D.F. loop antenna is fitted in the top of tail fuselage. The АМС-1 common antenna for P-800 radio and APK-5 A.D.F. is mounted on the top of the fuselage between the canopy and APK-5 loop.

Antenna leads-in are connected to the radio set and A.D.F. through the АФ-1 filter installed under the antenna flange.

The automatic direction finder is controlled from the control panels installed in both cabins.

Buttons on the levers of the control boards in the front and rear cabins are provided for operating the radio transmitter and СПУ-2 interphone equipment.

The radio equipment is supplied from a ПО-250 inverter installed on the starboard side between fuselage frames [redacted] and 1.

BRIEF DESCRIPTION OF THE RADIO EQUIPMENT MAIN UNITS.

The radio set includes:

1. Transmitter - "А" unit.
2. Receiver - "Б" unit.
3. Selenium rectifier - "В" unit.
4. Remote radio control panel "П" unit.
5. Antenna.
6. Set of cables.
7. Set of crystals.
8. Tuning unit - "И" unit.

The P-800 radio set is furnished with a crystal frequency stabilization of the receiver heterodyne and transmitter oscillator providing the communication without search and trimming during the operation.

The radio set is controlled from the control panel installed in the pilot's cabin. The radio set enables to perform the preliminary tuning to any four frequency channels and gives the possibility to establish the communication in flight at any of these frequency channels.

Quantity of operating frequencies and choice of a communication frequency depends on crystals available.

The tuning frequencies of the receiver and transmitter may be different. The transfering from reception to transmission is performed by pushing the button on the throttle lever.

TRANSMITTER - "А" UNIT.

The transmitter of the P-800 radio set consists of 6 stages operating with 8 valves. The amplitude modulation is used in the transmitter.

The transmitter provides a continuous operation by the following cycle:

[redacted] transmission for 2 minutes
[redacted] eception for 2 minutes
and uninterrupted transmission for 15 minutes.

25X1

25X1

RECEIVER - "5" UNIT.

The "5" unit is a 13 valve heterodyne receiver with a crystal stabilization of heterodyne frequency.

The automatic gain control of the receiver maintains practically constant volume level in the headphones.

To dicrease noise in the headphones the receiver is equipped with a noise limiter which automatically switches off the receiver when the carrier-frequency is absent.

The receiver is designed for continuous operation within 12 hours.

RECTIFIER - "B" - UNIT.

The "B" unit consists of two selenium rectifiers and serves to rectify c.p.s. a.c.

The "B" unit output voltages are as follows:

1. The anode supply of the valves at transmission - 310 v.; at reception - 275 v.
2. The bias circuit supply at transmission - 120 v.; at reception is 105 v.

Valve filaments is directly supplied from the aircraft electrical system.

THE CONTROL PANEL - "П" UNIT.

The remote control panel is a separate unit and it is installed in the pilot's cabin.

The volume control, the selector switch for switching on one or two receivers and frequency channel selector buttons are installed in the control panel.

[redacted]

25X1

SECRET

ANTENNA.

[redacted] 25X1

The antenna is a wide-band vibrator connected to the transmitter outlet or the receiver inlet through the relay installed in the "A" unit.

The relay selector buttons are installed on the throttle levers.

The common antenna for the P-800 radio set and APK-5 A.D.F. is connected to them through a separation filter, mounted in the antenna mounting.

SET OF CABLES.

The transmitter, receiver, rectifier and remote control panel are connected by means of the cables.

The radio cables consist of multicore wires of 0.35 mm^2 to 2.5 mm^2 soldered by their ends to the plug connector sockets.

To shield and secure the wires from the damage they are in metallic braiding.

SET OF CRYSTALS.

The radio set is furnished with a set of crystals marked with the numbers of the fixed waves. The tuning scales are calibrated in the same numbers.

TUNING UNIT - "И" UNIT.

The tuning unit is an instrument for tuning the radio set and checking the current and voltage in the main circuits.

The channel selector buttons, the ПМС-1 indicator and the selector switch are installed in the "И" unit.

The radio set complete tuning is performed on the ground by the two tuning knobs of the receiver and the three tuning knobs of the transmitter.

[redacted] 25X1

SECRET

When tuning the channels tune at the scale number given on the crystal to be inserted.

[redacted]

5. APK-5 AUTOMATIC DIRECTION FINDER.

The automatic direction finder set includes:

1. Receeiver.
2. Flash-mounted loop antenna.
3. Control panels in the front and rear pilots' cabins.
4. CYП-7-course indicator in the front and rear pilots' cabins.
5. Relay-junction box.
6. Set of cables.
7. Set of flexible shafts with a coupling.
8. Partition insulator.
9. Dehydrator.

The APK-5 automatic direction finder is designed for piloting the aircraft using the signals of homing and radio beacons, and broadcast radio stations with visual and aural course indication.

The automatic direction finder is furnished with two antennas: directional antenna (loop) and non-directional sense antenna.

The current received by the antennas is amplified and fed into the control system which energizes the electrical motor rotating the loop till the loop horizontal line of symmetry coincides with the direction to the radio station. In this case, the current received by the loop is equal to zero.

The transmitting selsyn picks up the loop rotation.

The receiving selsyn in the CYП-7 indicators repeat the rotation and indicate the angle between the longitudinal axis of the aircraft and the direction to the radio station. (bearing).

SECRET

[redacted] 25X1

25X1

SECRET

RECEIVER.

[redacted]

[redacted] eceiver of the APK-5 consists of the following 25X1
in units:

1. H.F. unit consisting of five circuits:loop, sense antenna,first and second amplifiers and heterodyne circuit.
2. Variable capacitor unit.
3. First and second filters of intermediate frequency.
4. Trap.
5. Phasing circuit.
6. Transformers and chokes.
7. Channel selector mechanism.
8. 6 relays of remote control and 15 valves.

FLASH-MOUNTED LOOP ANTENNA.

The loop antenna unit consists of a loop,rotating mechanism including electrical motor and reduction gear and radio-deviation compensator with transmitting selsyn.

The lopp antenna is a ferrite core type. The loop with a tap from the middle point is mounted on the ferrite core.

The loop ends are connected to the contact rings transmitting H.F. voltage to the A.D.F. receiver and the tap is connected to the common ground ring.

The rotating mechanism consists of a two-phase asynchronous motor with a cage rotor and a reduction gear consisting of 3 pairs of gears with the gear ratio of 600.

The radio deviation compensator consists of a case and limb.

24 threaded holes with screws are spaced 15° apart along the circumference of the base. By turning the screws, you change the shape of the compensating ring, on which the limb carrier slide runs, thus compensating the radio deviation.

CONTROL PANELS.

The control panels provide a full remote control of the automatic direction finder from the front and rear pilots' cabins.

SECRET

[redacted] 25X1

SECRET

25X1

The controls mounted on the A.D.F. control panel provide the following oper[redacted]

25X1

1. Selecting for reception of modulated and unmodulated signals by the "Voice-Tone" switch.

2. Selecting of the mode of operations: "Off", "Compass", "Antenna" and "Loop".

3. The receiver tuning. The receiver sharp tuning to operating radio station is checked by the tuning indicator.

4. Selecting of the receiver bands.

5. Manual control of the loop rotation, fast and slow.

6. Volume control.

7. Compass lights control.

8. Transferring the control from one control panel to another.

9. Actuating of the control panel operation signal light.

10. Obtaining maximum operating range using the sensitivity control.

A.D.F. COURSE INDICATORS.

The course indicator indicates the bearing of the radio station that is the angle between the longitudinal axis of the aircraft and the direction to the radio station with a deviation angle taken into account.

СУП-7 selsyn-indicators (contact selsyn) serve as course indicators.

The scale is graduated into 360° with a single scale division of 5°.

RELAY-JUNCTION BOX.

The relay-junction box is designed for transferring the A.D.F. control from one panel to another and it consists of two РП-6 relays switching on the control circuits of the front or rear cabin panel and a РП-2 relay controlling the both РП-6 relays operation.

SECRET

25X1

SET OF CABLES. [redacted] 25X1

The transmitter, loop, control panels of the front and rear pilots' cabins and relay-junction box are connected by means of the cables. The cables consist of multicore wires. The ends of the wires are soldered to the plug connector sockets or to the lugs. 25X1

The cables are shielded with metal braiding.

SET OF TUNING SHAFTS.

Tuning shafts are used for remote tuning of the receiver from the control panels.

For synchronous tuning the control panels of the front and rear pilots' cabins are interconnected by means of the tuning shafts through the coupling which is connected to the receiver by a tuning shaft.

PARTITION INSULATOR.

The non-directional common antenna lead-in passes through the A.D.F. shelf with the help of a partition porcelain insulator.

DEHYDRATOR.

The dehydrator prevents the loop mechanism from moisture condensation. The silicagel crystals are used for the moisture absorption. When the silicagel crystals absorbe the moisture they change their colour from blue to pink.

To renew the crystals activity dry them till they recover blue colour.

C. СПУ-2 -AIRCRAFT INTERPHONE EQUIPMENT.

The СПУ-2 - aircraft interphone equipment provides interphone communication between the two crew members and enables them to communicate through the radio set with other radio stations and operate with the A.D.F.

[redacted] 25X1

The interphone equipment operates in conjunction with a communication radio set and A.D.F.

The СПУ-2 interphone equipment consists of an amplifier control boxes.

AMPLIFIER.

The interphone amplifier is a L.F., two-stage, push-pull circuit, four-valve (13П1С) amplifier with transformers.

The amplifier is switched on by means of the miniature electro-magnetic d.c. relays.

The amplifier-to-other units connection is performed by shielding cables with plug connectors.

INTERPHONE CONTROL BOXES.

The interphone control boxes provide throat microphones and headphones connection, the headphones output change from the A.D.F. to the receiver(and vise versa)and volume control of receiving signals.

The helmets connection is performed with the help of the cord connector.

4. ELECTRICAL EQUIPMENT.

The aircraft power supply source is ГСК-1500М generator installed on the engine and the 12А-10 aircraft storage battery installed on the portside between the fuselage frames 0 and1.

The current from the generator is fed into the aircraft electrical system through the РК-1500Р generator control box and the СФ-3000Р filter which are installed on the firewall.

When the engine runs the generator supplies the current to all the power consumers as well as to the aircraft battery for charging.

SECRET

25X1

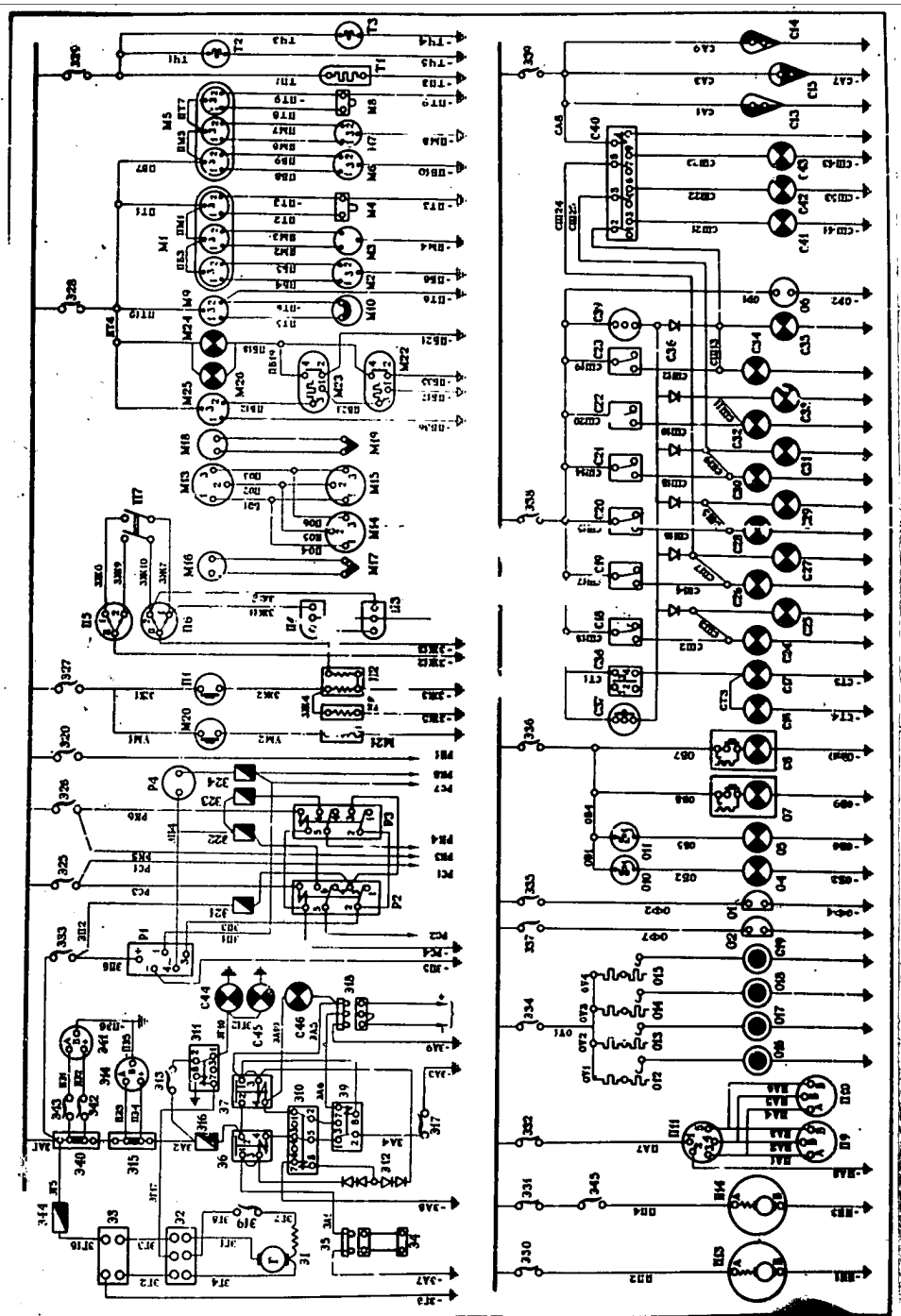


Fig. 28. Electrical Equipment.

SECRET

25X1

Э1 -generator; Э2 -aircraft storage battery; Э3 -filter;
-aircraft storage battery; Э5 -battery plug connector;
Э6 -contactor; Э7 -contactor; Э9 -relay; Э10 -relay;
Э11 -relay; Э12 -selenium cell; Э13 -circuit breaker
generator failure warning light; Э14-voltammeter; Э15 -ammeter
shunt; Э16 -fuse; Э17 -battery switch; Э18 -ground supply plug
connector; Э19 -generator switch; Э20 -circuit breaker, СПУ
interphone; Э21 -fuse; Э22 -fuse; Э23 -fuse; Э24 -fuse;
Э25 -circuit breaker, P-800 radio; Э26 -circuit breaker,
"АРК-5 A.D.F"; Э27 -circuit breaker, "Ignition";
Э28 -circuit breaker, "Instrument";
Э29 -circuit breaker, "Pitot static tube and clock";
Э30 -circuit breaker, ЭУП-53, "Turn and bank indicator";
Э31 -circuit breaker, ЭУП-53 "Turn and bank indicator";
Э32 -circuit breaker, АГИ-1 "Artificial horizon";
Э33 -circuit breaker, ПО-250 inverter;
Э34 -circuit breaker, "U.V.L";
Э35 -circuit breaker, "Landing light";
Э36 -circuit breaker, "Lighting";
Э37 -circuit breaker, "Taxiing light";
Э38 -circuit breaker, "Landing gear";
Э39 -circuit breaker, "Navigation lights";
Э40 -ammeter shunt; Э41-voltammeter; Э42 -circuit breaker,
ammeter; Э43 -circuit breaker, ammeter; Э44 -fuse;
Э45 -"Turn and bank indicator switch;
P1 - inverter; P2 - relay; P3 - relay; P4 - receptacle;
M1 - three pointer engine gauge;
M2 -fuel pressure gauge transmitter;
M3 -oil pressure gauge trasmitter;
M4 - oil temperature gauge transmitter;
M5 - three pointer engine gauge;
M6 - fuel pressure gauge transmitter;
M7 - oil pressure gauge transmitter;
M8 - oil temperature gauge transmitter;
M9 - mixture inlet temperature gauge;
M10 - resistance bulb, mixture inlet temperature gauge;
M11 - tachometer generator;
M12 and M13 - tachometer indicator;

SECR

M16 and M18 - cylinder head temperature gauge;
M17 and M19 - thermocouple, cylinder head temperature gauge; 25X1 25X1
M20 - oil dilution switch;
M21 - oil dilution valve;
M22 and M23 - duel contents gauge transmitter;
M24 - fuel reserve warning light;
M25 - fuel contents gauge;
M26 - fuel reserve warning light;
I - "Start" push button;
2 -booster coil;
3 -starting magneto, left;
4 -magneto right;
5 and 6 -ignition switches;
7 -ignition master switch;
8 -pneumatic solenoid valve;
9 and 10 -artificial horizon;
11 -artificial horizon inverter;
13 and 14 electrical turn-and-bank indicators;
1 -pitot static tube heating;
2 and T3 - A4X0 clock heating;
1 - landing light;
2 -taxiing light;
4 and 05 compass lights;
6 -portable lamp receptacle;
7 and 08 -white light lamps; 010 and 011 -rheostats;
12,013,014 and 015 - rheostats;
16, 017, 018 and 019 - U.V.L. equipment;
13 - navigation light, left;
14 - navigation light, right;
15 - navigation light, tail;
16 and C17 -"Trim neutral position" warning light;
18 - left leg "Up" position switch;
20 - nose leg "Up" position switch;
21 - nose leg "Down" position switch;
22 - right leg "Up" position switch;
23 - right leg "Down" position switch;
24 - left leg "Up" position warning light;
25 - left leg "UP" position warning light;

SECRET

25X1

SECR

- left leg "Down" position warning light;
- left leg "Down" position warning light;
- nose leg "Up" position warning light;
- nose leg "Up" position warning light;
- nose leg "Down" position warning light;
- nose leg "Down" position warning light;
- right leg "Up" position warning light;
- right leg "Up" position warning light;
- right leg "Down" position warning light;
- right leg "Down" position warning light;
- selenium cell (an assembly of six sections, two washers in each);
- lamps test button;
- limit switch;
- lamps test button;
- external warning lights relay;
- external warning light, right leg "Down" position;
- external warning light, nose leg "Down" position;
- external warning light, left leg "Down" position;
- generator failure warning light;
- generator failure warning light;
- ground supply warning lamp;

The battery and the ground supply are connected to aircraft electrical system through the power supply el, mounted on the bracing struts of the fuselage frame t the aircraft center line.

Power supply panel functions are:

It cuts out the aircraft battery when the ground supply is connected.
It doesn't switch on the aircraft battery or ground supply with wrong polarity.
It switches on the warning lights when the generator fails.
It switches on the external landing gear warning lights when the navigatio lights switch (installed on the switch board) is "On".

5. It switches on the supply from the П 0-250 inverter when "РСИУ" or "АРК" switches are "On".

In the power supply panel are installed:

The four ПАЛ-30-2 fuses in the radio equipment supply circuit (from the П 0-250 inverter;

the ИП-35 inertial fuses in the battery and ground supply circuit and the ИП-50 fuse in the generator circuit.

The aircraft battery is connected with the help of the ШР28П2НШ7 plug connector.

The ground supply is connected to the ШРА250АК receptacle, fitted on the port side of the fuselage between frames 4 and 5.

For measuring the voltage of the electrical system and current in the battery circuit the ВА-1 voltammeters are installed in the front and rear pilots' cabins and the ША-140 shunts are on the circuit breakers panel.

The circuit breackers panel is mounted on a bracing strut between the fuselage frames 1 and 2.

The circuit breaker panel also contains the circuit breakers for supply circuits of the П 0-250 inverter and ЭУП-53 turn and bank indicator and a circuit breaker of the rear cabin voltammeter.

Power consumers are:

1. The Р-800 radio set, АРК-5 automatic direction finder, СПУ-2 interphone and П0-250 inverter.
2. The navigation lights which consists of the two НАНО-45 wing tip lights and ХС-39 tail light.
3. The external and internal warning light system consisting of six ВК2-100 limit switches and twelve СМ-51 lamps, mounted on the instrument panels and three ХС-39 lamps fitted on the L.G. shock struts.
4. The starting ignition system which consists of the КП-4716 booster coil, ЭК-48 pneumatic solenoid valve and starting button.

25X1

SECRE

5. The instruments: ТУЭ-48 thermometer; ЭМИ-3К engine gauge unit; СБЭС1377 fuel contents gauge; АГИ-1 artifi- horizon with the ПАГ-1 inverter; ЭУП-53 turn ank indicator.

25X1

6. The pilot's cabin lights including the two КАСРК-45 wander lamps and two КН-12 compass lights with two РИК-49 rheostats and U.V. lights consisting of four РУФ 0-48 rheostats and АРУФОШ-45 lamps.
7. The ПВД-954 pitot static tube and АЧХО clock heating.
8. The ФС-155 landing light.
9. The ФР-100 taxiing light.

All the power consumers are switched on by circuit breakers installed on the switch panel of the instrument board in the front pilot's cabin.

The aircraft is equipped with a single wire electrical system. The wiring of the electrical system are bundled in wire harnesses.

All the wires are fitted with the wire labels numbered according to the electrical diagram.

The wire harnesses are protected against mechanical damages by a fabric tape and polychlorvinyl tube which is pushed down over the harnesses.

The wiring for the radio, ignition system and the leads from the generator to the filter and other leads are shielded.

All the cables from the switch panel and left instrument panel of the front pilot's cabin are equipped with plug connectors.

To facilitate dismantling the outer wing panel and rudder joints are provided, with the 73К,74К and 75К electrical connections.

To prevent radio interference and to have a common ground of sufficient electrical capacity, all the metal parts of the aircraft are electrically bonded by copper braiding strips.

The steel welded fuselage framework and wing centre section serve as a common ground.

SECRET

25X1

25X1

SECRE

The minuses of the consumers and power supply sources are connected to the aircraft common ground by means of contact pins welded to the fuselage framework by means of bolts to the elements of the wing centre section and outer panel. 25X1

A grounding stick is fitted on the half-axle of the L.G. right shock strut.

OPERATING NOTES.

I. AIRCRAFT FUELLING PROCEDURE.

1. AIRCRAFT FUELLING.

The B-70 gasoline with the octane number of not less than 70 (GOST 1012-54) is used for the aircraft fuelling.

The aircraft and fuellers must be carefully grounded before fuelling the aircraft. The aircraft electrical equipment should be switched off. No fuelling must be carried out whilst the aircraft engine is running and if there is an aircraft with the engine running within less than 25 metres of the aircraft being fuelled.

The fuel is delivered from a fueller to the tanks either simultaneously through two hoses or separately to each tank.

When fuelling the tanks separately mind that the fuel can pass from one tank to another and, if necessary, replenish the tank in 2-3 minutes after they have been fuelled.

The fuel level in the tanks must be 50 mm below the tank filler neck upper level.

The fuel quantity in the system is checked by the electrical fuel contents gauge on the instrument panel in the front cabin.

25X1

2. OIL FILLING. [redacted] 25X1

[redacted] 25X1

e oil MC-20 or MZ-22 (GOST 1013-49) is used for the aircraft oil system.

Deliver the oil directly into the tank only from an oil servicing truck equipped with a filter in its oil delivery system and gauze over the nozzle of a nose discharge cock.

When filling the tank from a can use a funnel with metal gauze.

The filling capacity of the whole oil system (oil tank, oil cooler, engine, pipe lines) is 23 litres.

The oil tank maximum operating capacity is 17 litres.

The engine operates reliably, if there is not less than 3 litres of oil in the tank.

The oil quantity in the tank is checked by the oil bayonet gauge fitted to the filler neck cap.

3. AIR SYSTEM CHARGING.

The air system is charged from a ground cylinder up to a pressure of 50±5 kg/cm2.

rning! Prevent moisture from getting into the cylinder. fore charging the air system, place the ground cylinder th the valve upward at an angle of 10-15°, open the valve ightly and blow out the charging hose. Then connect the se to the air charging connection and open the air system lve. Check the system charging by the pressure gauges. en charging check the reducing valve, unlock it, loose e lock nut, unscrew the cap (to reduce the pressure) and rew it in. Recharge the air system to check the adjustment the reducing valve. On completing the adjustment, tighten e lock nut and lock the valve.

[redacted] 25X1

SE

4. OIL AND FUEL DRAI

FUEL DRAINING.

To drain the fuel tanks and fuel systems:

a) Open the access door in the wing centre section lower skin under the fuel tank filter-sump drain cock (Fig.29):

b) Push the valve handle and turn it to the vertical position;

c) Drain the fuel tanks;

d) Unlock and remove the fuel drain plug of the filter located on the firewall;

e) Drain the fuel filter.

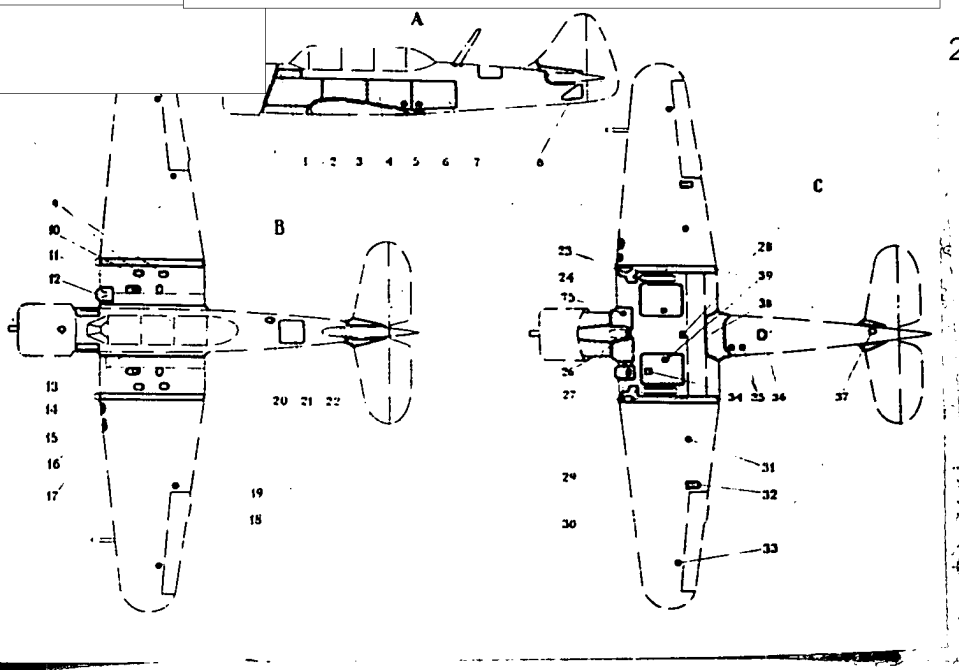
Note: Observe precautions against fire when draining the fuel system.

OIL DRAINING.

To drain the oil system:

a) Unlock and remove the oil filter drain plug;
b) Drain the oil system;
c) Unlock the engine oil sump filter nut;
d) Set a trough for oil draining;
e) Remove the filter and drain the engine oil system;
f) Open the access door to the oil cooler drain plug;
g) Unlock the drain plug;
h) Unscrew the plug one-two revolutions and drain the oil cooler.

SECRET



25X1

g. 29. Location of access doors.

- Side view (left-hand);
- Top view;
- Bottom view.

Canopy access door, instruments; 2,3,4 and 7) side
ening panels (panel 7 - on the port side); 5) access door,
r system ground charging connection (port side); 6) access
or, ground battery plug connection (port side); 8) tail
cess door (port side); 9) inspection doors, main gear;
) access door, fuel contents gauge; 11) access door,
el tank filler neck; 12) removable air intake, oil cooler;
) access door, oil tank filler neck; 14) removable fillet,
selage-to-wing centre section; 15) wing splice strip;
) removanle glass panel, taxying light; 17) removable
ass panel, landing light; 18, 19,31, 33) fabric covers,
lts of aileron control cable fittings and hinges; 20) in
ction door, automatic direction finder loop and stub ant
) removable glass panel, compartment for automatic dir
nder loop antenna installation; 22) removable fillet, t
it; 23) removable panels, wing centre section skin;

25X1

SE[redacted]

24) access door, fuel tank cells; 25) access door, water trap of pitot static tube pipe line: 26) access door, torque shaft [redacted] bracket; 27) front lower access doors, fuselage; 28) access door, fuel system filter-sump; 29) access door, oil cooler pipe connection; 30) access door, oil cooler drain plug; 32) inspection door, aileron control cables; 34) oil cooler duct shutter; 35) access door to drain sediment from air bottles; 36) inspection door, rudder control cable pulleys; 37) inspection door; 38) fuselage panel; 39) access door, fuel tank outlet connection.

25X1

25X1

AIRCRAFT PREPARATION FOR FLIGHT.

1. PRELIMINARY OPERATIONS.

. Release the aircraft from mooring cables.
. Remove the aircraft covers and clamps.
. Ensure that:
- L.G. position mechanical indicators project up through e wing centre section and fuselage nose section skins;
- ignition switches are set in "0" position;
- power consumer switches are in down position;
- starting button is turned fully clockwise;
- pressure in shock struts and tyres is normal,
e main L.G. wheels are chocked.
. Install the aircraft battery and bring a compressed r cylinder to the aircraft.

2. PRE-FLIGHT INSPECTION.

Before flight the aircraft, which was thoroughly spected the day before, must be subjected to a pre-flight spection.

The purpose of the pre-flight inspection is to check e aircraft for condition and its actual readiness for ight.

While inspecting:
- check the aircraft for freedom from foreign objects d outer damages;

25X1

[redacted] 25X1

SECR[redacted]

- check the amount of fuel in the tanks by the electrical fuel contents gauge (120 litres), the ammount of oil by oil bayonet gauge (not less than 15 litres) and air pressure in the system by two-pointer air pressure gauge (... kg/cm^2);

[redacted] 25X1

- check the battery voltage by voltammeter (not less than 24 volts);
- check the fuel system for tightness, to do this build-up pressure of 0.3-0.5 kg/cm^2 by the hand pump and close the shut-off valve. Pressure drop within 3 minutes is not permitted;
- check the L.G. for condition: tyre static reduction (for main L.G. wheels - 30 mm. for the nose L.G. wheel - 20 mm), L.G. shock absorbing (by shaking the aircraft by the wing outer panels; inspect the shock strut rods for fluid leakage traces, tyres for damages, L.G. locks and hinge joints for cleanliness, L.G. position mechanical indicators for condition;
- check the flying controls for condition;
- ensure that the control sticks and pedals deflection correspond to that of the elevator rudder and ailerons;
- check the fyling controls system and hinges for freedom from plays, trim tab and balance tabs for condition and security;
- check the power plant for condition: oil system drain plugs locking, tank filler neck caps for security and locking, propeller blades for freedom from plays, cowling panels for condition and attachment;
- check the access doors and their locks for operation;
- check the oil and fuel system vent lines for freedom from clogging;
- ensure that the transmitter and receiver are tuned to required frequency;
- check the clock for winding up and see the time;
- check the altimeter and rate-of-climb indicator pointers for setting of zero;
- check the lighting system for proper operation (before night flying);

[redacted] 25X1

- check the radio set for reliable communication with other radio stations when the engine is running; 25X1

[redacted]n sediment from the fuel filter-sump;

- wipe the canopy glass panels with a clean baize or chamois. Check that there is no friction between glass panels of the sliding and fixed canopy parts. 25X1

3. PREPARATION FOR STARTING, STARTING, WARMING UP, TESTING AND STOPPING OF ENGINE.

PREPARATION FOR ENGINE STARTING.

Before starting the engine, ensure that fire fighting equipment is at the parking place, the landing gear wheels are chocked and there are no foreign objects in front of and behind the aircraft and in the plane of propeller rotation.

If the engine was inoperative for more than three days, apply 1,5 litres of oil into the crankcase through the front and rear breathers and spray 60-70 grm of oil into the cylinder with the piston being in the bottom dead centre.

Before starting the cold engine, turn the propeller 3-4 revolutions in the direction of rotation.

CAUTION: Before starting the engine after depreservation and after the engine has been inoperative for more than three days, remove the intake pipe drain plugs and front spark plugs of cylinders 4,5 and6, turn the propeller and drain the oil from the cylinders and pipes.

Before starting the engine, sit down in the front cabin, check the cowl and oil cooler shutters controls for correct operation, set the throttle lever in a position to obtain 800-900 r.p.m., set the propeller control lever in the "high pitch" position, close the mixture control, open the shut-off valve, close the cowl and oil shutters, set the carburetor air heat control lever in "on" position (lever pushed forward), set the elevator rudder and ailerons controls in the neutral position.

[redacted] 25X1

[redacted] 25X1

SE[redacted]T

Being sure that the engine ignition system is "off" give the command: "turn the propeller" with the propeller rotating, prime the fuel into the mixture chamber (2-5 strokes by the pump plunger depending on the ambient air [redacted] 25X1). Do not turn the propeller by hand, when the engine is hot.

STARTING THE ENGINE.

The engine is started by compressed air under a pressure of 15-50 kg/cm^2. Before starting the engine give the command "all clear", hearing the answer "yes, all clear", move the ignition switches in both cabins to "1+2" position, unlock the starting button (turn it fully counter clockwise), set the switches "battery","ignition","instruments" and "landing gear" on the switch panel in the "on" position.

Ensure that the air system valve is opened and push the starting button.

After the first fires make 2-3 strokes by the priming pump for better engine operating from the carburettor.

If the engine does not fire, switch off the ignition and repeat starting.

When the engine has been overprimed, open the throttle wide and clear the cylinders, rotating the rpopeller 3-4 revolutions in the opposite direction of rotation.

If the engine does not start after three of four attempts, stop starting, investigate the trouble and remove the defect.

As soon as the engine begins to operate properly retard the throttle lever to 700-800 r.p.m. and note the oil pressure.

If the oil pressure does not reach 2,5 kg/cm^2 within 30 seconds, stop the engine, find out the cause of trouble.

CAUTION: After starting the engine lock the priming pump plunger (push the plunger down and turn it through 90°).

SECRET

[redacted] 25X1

WARMING-UP THE ENG [redacted] 25X1

[redacted] the propeller in low pitch position in 0.5-1 [redacted] after starting the engine. 25X1

The engine should be warmed-up with the propeller in low pitch position at 700-800 r.p.m. till the oil inlet temperature begins to rise, then increase the engine up to 1,000-1,200 r.p.m. and continue warming-up the engine. When the oil temperature is not below 30° and the cylinder heads temperature is 120° the engine is considered to be warmed-up.

ENGINE GROUND TEST.

a) Check the cowl oil cooler shutters controls for correct operation: ensure that there is no seizing when opening or closing the shutters:

b) Check the compressor operation at a speed of 1,500 r.p.m., shut the air system valve. Discharge the air from the system by operating the [redacted]-6 levers.

Then the air pressure in the system should increase, as measured by the pressure gauge; open the air system valve.

c) Check the engine operation at normal rating, by opening the throttle wide, and obtain 2050 r.p.m. by operating the propeller pitch control lever. The instruments readings should be as follows:

- manifold pressure - 30±10 mm Hg.
- oil pressure 4-6 kg/cm^2
- fuel pressure 0.2-0.5 kg/cm^2

d) Obtain 1,860 r.p.m. (with the propeller set in low pitch position), check the magneto and spark plugs for correct operation, with the ignition switches in the "1" and "2" positions.

The engine normally decreases speed by 60 r.p.m. when operating on one magneto within 30 seconds.

[redacted] 25X1

[redacted] 25X1

S[redacted]ET

When changing from one magneto to the other ,switch [redacted] magnetos for 20-30 sec."to fire" the spark plugs. [redacted]re that the engine runs smothly and without vibration. 25X1

e) Check the propeller and constant speed governor for correct operation. To do this set the propeller in low pitch and the throttle lever in a position to obtain 2,000 r.p.m. Set the propeller in high pitch position without moving the throttle lever. The engine speed should decrease to 1,300-1,400 r.p.m. Setting of the propeller in low pitch should results in increasing the engine speed up to 2,000 r.p.m.

f) Check the propeller and the P-2 constant speed governor for onspeed operation. To do this, set the throttle lever to obtain 2,000-2,050 r.p.m. at low pitch, then set the propeller in high pitch position to decrease engine speed to 1850 r.p.m. Without changing the propeller pitch, smoothly move the throttle lever in both directions without reaching the extreme positions.

R.p.m. should be constant in some manifold pressure range.

Rapid opening and shutting of the throttle results in increasing and decreasing the engine speed by 50-100 r.p.m. but after 2-3 seconds the onspeed r.p.m. should be obtained again.

g) Check the engine operation at low speed with the propeller in low pitch position. Instruments readings should be as follows: engine speed - 500 r.p.m.;

oil pressure - not lower than 1.5 kg/cm^2;

fuel pressure - not lower than 0.15 kg/cm^2.

CAUTION: Do not continuously run the engine at low speed to prevent the spark plugs from being covered with oil.

h) Check the engine operation at take-off rating [redacted] 30-35 seconds (open the throttle wide, set the propeller in low pitch position). Instruments readings should be [redacted]

[redacted] 25X1

engine speed - 2,325-2,375 r.p.m. to [redacted] 25X1
manifold pressure - 35±10 mm Hg;
oil pressure - 4-6 kg/cm^2;
[redacted]ressure - 0,2-0,5 kg/cm^2. 25X1

Check the electric system voltage (not more than 28,5 v.)

1) Check the engine accelerating ability. Change smoothly the engine operation from low speed to take-off rating within 2-3 seconds.

2) Check the generator for correct operation: to do this, run the engine at low speed, move the "battery" switch in "off" position and smoothly increase engine r.p.m. The generator shall operate at 1,100-1,200 r.p.m. providing a supply of 23,5-24,5 v. Test the engine at all ratings to ensure that there is no malfunctioning, knocks, vibration, overheatting and smoke generation.

During the engine ground test maintain cylinder heads normal temperature (not higher than 230°C), oil temperature (not higher than 75°C) carburetor air inlet temeprature (not lower than 5°C) by operating the cowl and oil cooler shutters and carburetor air heat controls.

STOPPING THE ENGINE.

Before stopping the engine it is necessary to cool it. To do this, open the cowl and oil cooler shutters;
- set the propeller in low pitch, obtain 700-800 r.p.m. and reduce the cylinder heads temperature to 140-150°C;
- increase engine speed up to 1,900-2,000 r.p.m. for 20-30 seconds, set the propeller in high pitch position, decrease engine speed to 600-700 r.p.m., cut the ignition switch and smoothly open the throttle.

After stopping the engine cut the switches on the [redacted] lock the starting button, open the cowl [redacted] the oil system connections for leakage. [redacted] which have been found during the engine [redacted] the airframe.

[redacted] 25X1

25X1

SECRET

[redacted]

PRE-FLIGHT INSPECTION.

25X1

[redacted]-flight inspection is carried out when preparing the aircraft for repeated flight without taxiing to the parking place. During the inspection:

1. check the propeller for condition;
2. inspect all oil, fuel and air lines for leaks;
3. check the oil and fuel vent lines for condition;
4. check the L.G. shock-absorbing, examine the L.G. hinge-joints and L.G. "up" locks for condition;
5. check the dust filter cleanliness;
6. check the airframe and flap skin for damages.

After a rough landing carefully examine the landing gear on the line where the aircraft is given the pre-flight inspection.

III. AFTER-FLIGHT INSPECTION.

After-flight inspection is carried out as a rule at the end of a flying day and is a main inspection.

Before performing the after-flight inspection place the aircraft on trestles, open all the access hatche doors and cowl panels, remove dust and dirt from the aircraft.

1. POWERPLANT INSPECTION.

1. Check the propeller for security of attachment and locking.
2. Examine the cowl shutters attachment for security
3. Check the engine-to-engine mount attachment and locking, engine mount shock absorbers for condition (check the rubber for cracks and elasticity).
4. Check the engine control cables attachment for condition, locking and security; check the adjustment of the control levers extreme position, check throttle, pitch and mixture control levers for synchronization.

[redacted]

25X1

25X1

SE T

Check the control cables for free movement.

5. Check the oil and fuel systems pipe lines for condition, check the connections for security and lock- 25X1
ck the oil sump filter.

6. Check the pipes of the compressed air starting system for condition.

7. Check the generator and air compressor blust tubes for condition and security.

8. Check the oil tank attachment, strap turnbuckles locking, check the oil cooler for condition and security of attachment and the cooler core for cleanliness.

9. Check the magneto, air compressor, fuel and oil pumps, 772A valve for security and locking.

10. Check the air system and boost gauge pipe lines for condition and security.

11. Check the ignition wiring harness for condition of shielding and security of attachment.

12. Examine the carburetor, air heater for security of attachment and the dust gause and sealing for condition.

13. Check the engine mount, and cowl panels hinges for condition, security of attachment and locking.

14. Check the cowl panels and their fasteners for condition.

15. Check the deflector for condition, security of attachment and clearances. The clearance between the cylinder head and the deflector should be 1 to 2 mm. , clearance between the cylinder and deflector fairing- 10 to 12 mm (distance between the deflector fairings for Nos.1,2,9 cylinders = 60 mm., for Nos.3,4,5,6,7, 8 cylinders = 20 mm).

16. Check the oil cooler and cowl shutters controls for condition, security of attachment and locking.

17. Check the carburetor plugs for security of locking.

SECRET

25X1

SECRET

AIRCRAFT FUEL SYSTEM [redacted] 25X1

[redacted] 25X1

1. Check the fuel system for tightness under a pressure of 0,3-0,5 kg/cm^2 with the shut-off valve closed.

2. Check the gauze and gaskets of the fuel filter on the fire wall for condition.

3. Check the 772A oil dilution valve for tightness with the outlet fuel pipe. Set the "Battery" switch in "on" position and deliver the fuel by the hand pump. (ensure that there is no leakage).

4. Check the pipe lines for condition and the connections for security of attachment and locking.

5. When supplying the fuel by the priming pump, check the priming system for correct operation and tightness.

6. Check the fuel pump plug vent hole (1 mm.dia.) for freedom from clogging.

3. LANDING GEAR AND FLAP INSPECTION.

1. Check the flap shock cord, brackets, pulleys, cables and L.G. operating jack for condition, security of attachment and locking; see that the flap closely fits the wing centre section when the flap control valve is in the neutral position and inspect the hinge for condition.

2. Check the discs of the wheels with brakes for freedom from play, attaching nut for tightening and locking half-axle nut for locking, discs for damages and free movement when rotating the wheels, check the tyres for condition and see that the caps are on the inflating valves.

3. Check the [illegible] links and brace strut bolt nuts for [illegible], locking, freedom from play and cracks.

4. Check the collars coupling the check strut cylinders for [illegible], locking and freedom from play.

5. Check the operating jacks-to-brace struts and [illegible] attachments for security, locking and freedom from play.

[redacted] 25X1

25X1

SECR

25X1

6. Check the rods working surfaces for condition and leakage of hydraulic fluid; wipe the rods and cover them [illegible] a thin coating of technical vaseline.

7. Check the main gear "up" locks for condition, security of attachment, locking and correct functioning.

8. Check the nose gear wheel for freedom from play, axle nut for tightening and locking, check the wheel for free movement, the tyre for condition and see that the cap is on the inflating valve.

9. Check the torque links and brace strut bolt nuts, and the nuts of the shock strut attachment fitting bolts for tightening and locking.

10. Check the shimmy damper for condition, security of attachment and locking; check the shimmy damper and cam mechanism when turning the wheel fork (time to return should not exceed 10 sec.) for correct operation, freedom from play and leakage of hydraulic fluid.

11. Check the operating jack-to-the fuselage frame attachment fitting for security and locking; check the rods, bell cranks and nose gear mechanical position indicator for security of attachment and locking.

12. Check the jack rod-to-the brace strut attachment for security locking and freedom from play.

13. Check the shock strut elements and fuselage framework attachment fittings for freedom from cracks and distortion.

14. Check the L.G. "Up" locks for condition, security of attachment, locking and proper functioning.

15. Check the shock strut and jack rods working surfaces for condition, and freedom from leakage of hydraulic fluid; wipe the rods and lubricate them with [illegible] vaseline.

16. Fill the grease cups with lubricant.

SECR

25X1

SEC

4. INSPECTION OF AIR SYSTEM, CHECK OF LANDING GEAR AND FLAP FUNCTIONING.

25X1

1. Drain sediment from the air system filter/sump.

2. Check pipe lines and their connections for condition, security of attachment and locking; check valves, pipe connections, adapters, crosses, pressure gauges, cocks, strainer, filter/sump, differential control unit, main and emergency cylinders, ПУ-6 levers and pipe-lines for condition, security of attachment and locking.

3. Check the flap and landing gear for proper extention and retraction at backpressure, check the L.G. position indicator and warning light system for correct functioning, check the system with the L.G. control valves in "up" or "down" positions for air tightness.

The main shock struts should operate synchronously. When extending the L.G., the nose gear nonsynchronous operation should not exceed 2 sec., when retracting the L.G. - should not exceed 10 sec. Synchronous operation is obtained by increasing the damper holes up to 1.2 mm.

4. Check the L.G. emergency extension system for proper operation.

5. Check the L.G. wheels for synchronous operation and proper braking.

5. INSPECTION OF AIRCRAFT CONTROLS.

1. Check the elevators, rudder and ailerons hinges for free from play, for security of attachment and locking.

2. Check the elevators and rudder for free movement.

3. Check the control sticks, pedals and control rods for proper connection, locking, for freedom from [illegible] and cracks.

4. Check the control cables for condition, splicing, tension, security of attachment, and locking; see that the control cables do not contact the units and structure [illegible] bulk members.

25X1

SECRET

5. Check the bracing wires, brace struts and their attachment fittings on the stabiliser and fin for condi-

6. Check the trim tab control system for proper operation and the neutral position warning light system for correct functioning; check the wiring for condition, hand-wheels for freedom from play and the switch for security of attachment.

7. Check the control sticks gaiters for condition and security of attachment.

6. INSPECTION AND CHECKING OF THE AIRCRAFT ELECTRICAL EQUIPMENT.

1. Question the pilot about the operation of the electrical equipment, remove the defects found during the flight.

2. Check to be sure that the generator is securely attached and locked, that the generator cable and the magneto leads are in good condition and securely attached, that the insulation of the booster coil H.T. leads are in good condition and secure.

3. Check that the TY3 -48 thermometer resistance bulbs and the wiring are securely attached and locked.

4. Check the thermocouples wiring for condition and security of attachment, and for clearances between the leads and deflec or fairings.

5. Check the oil thermometer resistance bulb for security and locking, the wiring for condition and security of attachment.

6. Check the generator control box, circuit breaker panel, switch panel, booster coil, filter, oil dilution valve, pneumatic solenoid-operated valve and starter button for condition and security, the wiring for condition and the plug connecters for tightening. Remove dust from the assembly of the selenium washers installed on the left instrument panel.

25X1

SECRE

7. Check that the tachometer generator, flexible shaft are in good condition and securely attached, that the plug connectors of the wiring to the indicator are tightened and [illegible]ked.

25X1

8. Check that the oil and fuel pressure gauge transmitters and wiring to them are in good condition and locked, that the plug connectors are tightened and locked.

9. Check the relay-junction box for condition and security, the plug connector for tightening and locking.

10. Check the limit switches for condition, security and correct functioning (free travel of the limit switch rods should not be less than 2-3 mm.).

11. Check that the inverter and the wiring to it are in good condition and securely attached.

12. Check the navigation lights, L.E. position external warning lights, wiring to them, terminal boxes, plug connectors and receptacles for condition and security of attachment.

13. Ensure that the landing and taxiing lights and their glass panels are in good condition.

14. Check the cable shielding for damage, [illegible] condition and the sampling [illegible] for security.

15. [illegible] that the cable harnesses are [illegible] sharp bends and contact with the edges of the [illegible] that the rubber bushings and clamps are in good [illegible] and securely attached.

16. Check the cables and terminals for [illegible]

[illegible]

25X1

SECR [redacted] 25X1

[redacted] 25X1

19. Check the lighting, warning and heating equipment for correct operation by switching on the consumers when the aircraft electrical system is supplied from the ground battery.

Check the L.G. position warning lights test circuit.

20. Check the battery voltage under the load (the voltage should be not less than 24 v.).

7. INSPECTION AND CHECKING OF AIRCRAFT RADIO EQUIPMENT.

1. Question the pilot about the operation of the radio equipment, remove all the defects found during the flight.

2. Check that the shock-absorbed mountings and radio units are in good condition, securely attached and locked.

3. Check that the mast antenna and lead-in contact is securely attached.

4. Check that the radio cables are in good condition and securely attached, that the plug connectors are tightened, and tuning shafts cases are shielded and bonded.

5. Check that the APK-5AF control panel, head set connection blocks and handles are securely attached, that the plug connectors are tightened.

6. Check the CYN-7 pilot's indicator for security of attachment, plug connectors for tightening and switches for condition.

7. Check the bonding strips of the aircraft and engine units for condition, and contacts for security.

8. Check the ARK-5 automatic direction finder for proper functioning when it is supplied from the ground battery:

- switch on the "Battery" and "ARK" switches on the control panel;
- set the function switch on the APK-5 control panel to "Comp", "Ant" or "Loop" position and make sure that the switch operates correctly, lights and contacts [illegible]

[redacted] 25X1

SECRE

are on, the tuning indicator pointer deflects and there is noise in the head-phones);

- check the dimmer and volume control for functioning;

- set the band selector of the APK-5 control panel in "640-1300" position;
- rotating the tuning crank from one stop position to another, make sure that the remote tuning mechanism is serviceable;
- set the function switch in "Ant" position, turn the "Volume" control knob to the extreme right position, the band selector to the first band position and with the help of the tuning crank tune in any radio station;
- set the function switch in "Comp" position. In this case the pointer of the GYM-7 pilot's course indicator should indicate the bearing of the radio station;
- check the function switch for proper operation;
- check the "Voice-Tone" selector switch for proper functioning by hearing the tone of 800 c.p.s. in the headphones when the switch is in "Tone" position; when the switch is in "Voice" position the tone is not heard;
- make sure that the "Control" button transferring the control from one panel to another operates correctly;
- set the function switch in the "Loop" position, turn and push the "Loop - L-R" control knob, set the pointer of the GYM-7 indicator rotates quickly and in respective direction; the pointer should remain still if the switch is only turned without pushing;
- switch off the APK-5 ARP.

9. Insert the required crystals in the radio transmitter and receiver.

10. Connect the testing unit ("K" unit) to the receiver and transmitter and tune the radio set from the ground battery in accordance with the set tuning instructions.

11. Using the throttle lever check the operation of the radio transmitter and GYM-2 indicator on the various frequencies.

SECRET

25X1

12. Check the intercommunication through the CNy-2 erphone by hearing a voice side-tone, and check the 25X1 dio communication with other stations when the radio t is supplied from a ground battery for proper nctioning.

13. Check that the sellicagel crystals in the dehyd- ter tube installed on the APK-5 A.D.F. loop antenna d not change their blue colour.

Dry the crystals if necessary.

8. INSPECTION AND CHECKING OF AIRCRAFT INSTRUMENTS.

1. Question the pilot about the functioning of the rcraft instruments, remove the defects found during e flight.

2. Check that the instruments are in good condition d securely attached, that the pointers are in correct sition, that the mounting parts are in good condition.

3. Check the instrument panels for secure attaching, presence of the clearances between the shock-absorbed strument panels and the aircraft parts(it should be less than 3 mm), the shock absorbers for condition and ure attaching.

4. Check the pitot static tube pipe line for ... and secure attachment, clips for tightening, pitot tube for ... attachment.

... with the help of the ... tester, check the ... pipe line of the ... pitot static tube for ... ness under the pressure and vacuum corresponding to ... km.h. on the speed indicator (the ... should not exceed 15 km.h. or 3 per cent of the ... ing one minute.)

SECRET

25X1

[redacted]

25X1

9. INSPECTION OF THE CABINS FOR FREEDOM FROM FOREIGN OBJECTS AND DAMAGES TO THE SKIN.

1. Check the doors and fillets for security of attachment; check the door hinges for condition.

2. Check the canopy glazing and locks for condition and moving parts for proper functioning.

3. Check safety belts for condition and security of attachment and the locks for proper functioning.

4. Check the seats for security of attachment and cabin ventilating system for correct operation.

5. See that there are no foreign objects in the cabins, on radio mounting panels, canopy, cabin floor, in tail fuselage, wing center section, wing, fuselage and power plant compartment.

6. Check the skin of the wing, fuselage and tail unit for damages.

After inspection and remedy of damages and defects found in flight remove trestles from under the aircraft, close the access doors and cowl panels and cover the aircraft.

IV. AIRCRAFT AND ENGINE PERIODIC MAINTENANCE OPERATIONS.

Besides pre-flight and after-flight servicing, perform special preventive operations after thorough checking of the aircraft as specified for after-flight inspection.

Preventive operations are divided into:

1. Maintenance operations.
2. Periodic operations.

1. OBLIGATORY OPERATIONS AFTER DAY'S FLYING.

[redacted]

25X1

1. Perform after-flight inspection.
2. Drain sediment from air system filter-sump.

[redacted] 25X1

[redacted] 25X1

3. Drain sediment from the engine oil system and oil cooler.

4. Wash the gauze of the carburetor air intake.

2. PERIODIC OPERATIONS FOR PREPARING THE AIRCRAFT FOR WINTER AND SUMMER OPERATION.

1. Remove all the fillets and inspect the fuselage, wing center section and tail unit joints and attachment fittings.

2. Drain the fuel and shaking the aircraft by the wing outer panels and tail, rinse the fuel tanks.

Check the filter-sump gauze and gasket for condition.

3. Remove, wash and clean compressed air bottles.

3. AM-14P ENGINE MAINTENANCE (series 3).

After the aircraft first test flight with a newly installed engine.

1. Remove the engine cowl, check the power plant for condition paying particular attention to security of the accessories and pipe lines attachment; check the connections for fuel and oil leakage and exhaust manifold for exhaust gas breaking through the joints.

2. Remove the oil pump and constant speed governor filters (oil inlet), wash the filters and check them for condition.

3. Remove and wash the carburetor filter and fuel system filter which is installed on the fire wall.

4. Remove the magneto shielding and distributor blocks, check the breaker for condition.

There should be no preservation lubricant.

5. Remove the propeller, tighten the nut of the [illegible] reduction gear shaft thrust bearing. Inspect the splines of the shaft front end, propeller hub and tapered fit condition. Inspect the propeller, mount it on the [illegible] tighten the propeller nut at a torque of 55-60 kg-m.

[redacted] 25X1

6. Remove damages found by the pilot in flight.

AFTER EVERY 25 HOURS OF ENGINE OPERATION.

1. Inspect the engine as specified for after-flight inspection.

2. Remove the rocker box covers, check the valve springs, rockers and plates for condition. Check the rollers and valve rod ends for clearance (0.3-0.4 mm). Replenish the boxes with HK-50 lubricant.

3. After 25 hours of engine operation, remove the propeller and tighten the nut of the reduction gear shaft thrust bearing. Inspect the splines on the shaft front end, propeller hub and tapered rings for condition. Inspect the propeller and check the propeller nuts for tightening. Mount the propeller.

4. Check the engine assemblies and accessories attaching nuts for tightening and locking, check the ignition system connections for security.

5. Wash the carburetor air intake gauze.

6. Remove the carburetor fuel and air filters and see that they are clean.

7. Remove, wash and check the oil sump filter.

8. Check the engine controls, remove the play and lubricate all the connections.

Check the control levers for free movement and see that extreme positions of the accessories control arms correspond to those of the control levers.

9. Change oil in the oil system.

AFTER EVERY 50 HOURS OF ENGINE OPERATION:

1. Perform the same maintenance operations as after 25 hours' engine operation.

2. Check compression in all engine cylinders by a pressure gauge at the heads temperature of 40-60°C (pressure should be 1.3-3 kg/cm^2).

3. Tighten the propeller thrust nut.

25X1

AFTER EVERY 100 HOURS OF ENGINE OPERATION:

1. Perform the same maintenance operations as after 50 and 50 hours' engine operation.

2. Remove the propeller, tighten the nut of the shaft thrust bearing; inspect the splines, shaft front end, propeller hub and centering cones for condition.

3. Remove, examine and wash the filters of the oil pump, oil pump and constant speed governor.

4. Remove and wash the oil pump reducing valve.

5. Remove the carburetor drain plug and drain sediment from the fuel chamber; blow out the suction jet with air under a pressure of not more than 0.2 kg/cm^2.

6. Check the compressor attachment for security; remove the hoses connecting the compressor to the filter; remove oil from the hoses and blow them out with air.

7. Remove the shielding with distributor and the magneto upper cover; check the breaker for condition (clearance between contacts being 0.25-0.35 mm); clean the distributor contacts; check the H.T. leads-out, transformer attachment and distributer finger-to-cam attachment for security. Cover the breaker spring with a light coating of [illegible] turbine oil.

8. Perform the following operations on the GK-1,500M generator:

a) check the terminal nuts and bolts. If the terminal bolts are loose, tighten the nuts;

b) check the brushes for correct installation and free movement in brushholders. See that the springs pressing the brushes to the commutator are in place;

c) measure the brushes length (it should be not less than 15 mm.). Fit new brushes to the commutator using sandpaper No.00, and blow out the generator;

d) check the brush contacts for damage;

e) examine the commutator working surface; remove roughing with a cloth dampened in gasoline or with sandpaper No.00, blow out the generator;

f) check the poles attachment bolts for security.

[redacted] 25X1

[redacted]R EVERY 200 HOURS OF ENGINE OPERATION:

1. Perform the same maintenance operation as after 30 and 100 hours' engine operation.

2. Remove СД-49СМ spark plugs from the engine, examine electrodes and wash them with gasoline; adjust clearances between the electrodes (0.40-0.46 mm). Check the spark plugs for sparking at a pressure of [illegible] atm. for 30 sec. and for tightness at a pressure of [illegible] atm.

3. Wash the oil tank, oil cooler and oil pipeline [illegible] kerosine.

AFTER EVERY 300 HOURS OF ENGINE OPERATION:

1. Replenish the ЦИАТИМ-201 lubricant in the generator bearing No. 302.

4. AIRCRAFT MAINTENANCE OPERATIONS.

After five hours' flying:

1. Wash the aileron, elevator, rudder trim tabs [illegible] hinge joints with clean gasoline and inspect thoroughly; check the bell cranks and rods for [illegible] and cables for [illegible] all the [illegible] and pulleys with [illegible] lubricant.

2. Check the oil [illegible] lines and the [illegible] condition and security of attachment, [illegible]

[illegible]

[redacted] 25X1

[redacted] 25X1

AFTER EVERY 25 HOURS' FLYING.

1. Remove the access doors and check the fuel tanks r condition and security of attachment.

2. Check the fuel system pipe lines for security of ttachment and condition.

3. Drain sediment from the air bottles.

4. Check the bolt rubber inserts of the ailerons, evators and rudder movement stops for condition.

5. Check bonding strips for condition and security attachment.

6. Check the oil system pipe lines for security of ttachment and condition.

7. Check the oil cooler and its ducts for security attachment.

8. Check the propeller high and low pitch stops for rrect adjustment.

9. Check the control systems of the cowl shutters nstant speed governor, oil cooler duct shutter for mages and distortions; check the cowl shutter discs, opeller pitch stops bracket, oil cooler duct shutter d control system of the cowl shutters and oil cooler ct shutter for condition and security of attachment.

10. Check the air compressor and generator blast tubes r condition and security of attachment.

11. Inspect the radio equipment mounting panel located tween fuselage frames 4 and 5 for distortion and security its attachment to the fuselage.

AFTER EVERY 50 HOURS' FLYING.

1. Carry out 25-hour maintenance operations.

2. Clean the oil system strainer.

3. Inspect the cowl shutters and their control system, the bearings of the cowl shutter moving disc and push [illegible]

4. [illegible] water-free lubricant, and then transferring [illegible] the bowden cables of the [illegible] control cable [illegible] the engine [illegible] and over the rod end [illegible]

[redacted] 25X1

5. Remove the differential control unit, clean its
s and coat them with alcohol-glycerine fluid.
6. Remove the splice strips and inspect wing-to-
r section attachment fittings.
7. Remove the wing fillets and inspect the wing cen-
section-to-fuselage framework attachment fittings.
8. Examine the fuselage longerons and brace struts
a magnifying glass. Check them for freedom from
s and distortion.
9. Remove the tail fillet and inspect the tail unit-
uselage attachment fittings.
10. See that the elevator balance weight does not
act the edges of the fin rib cut-out and the elevat-
ntrol cable.
11. Check frame 1 lower tube for freedom from cracks
distortion in the point of the nose gear brace strut
ment.

AFTER 100 HOURS' FLYING.

1. Carry out 50-hour maintenance operations.
2. Inspect the elevators, rudder and ailerons, wash
coat the hinges with ЦИАТИМ-201 lubricant; check
ngles of the control surfaces movement.
3. Remove the canopy sliding parts, wash and coat
side rails and bearings with ЦИАТИМ -201 lubricant.
4. Connect the ground cylinder to the air supply
ection; disconnect the air system pipe lines from the
; ЗК-46 valve, and L.G. shock; blow out the system
compressed air under a pressure of 90 kg/cm^2 operat-
-6 valve, flap control valves, L.G. emergency
control valves.
Inspect the control stick torque shaft and pedals,
check the torque shaft and pedals for freedom
play and grease all the hinges and bearings with
-201 lubricant.
Check the elevator, rudder and ailerons hinge bolts
clean gasoline, inspect them for condition and grease with
ЦИАТИМ -201 lubricant.

7. Remove and disassemble the air system non-return lves; inspect the spring, brass valve and polychlorvinyl sealing gasket for condition; in case of excessive wear, change the gasket.

8. Inspect the wing center section riveted seams for condition.

AFTER EVERY 50 LANDINGS.

1. Replenish ЦИАТИМ-201 lubricant in all L.G. hinge joints, and ЦИАТИМ-201 lubricant with 15% of graphite in the grease cups of the torque link bolts.

2. Use magnifying glass to inspect all the L.G. fittings for cracks.

3. Inspect the ball insert of the nose gear brace strut for condition. Inspect the brace strut links surfaces in the centre hinge joints for freedom from scratches.

4. After every 50 L.G. and flap retractions or extensions: coat the L.G. "up" lock, jack auxiliary chambers with ЦИАТИМ-201 lubricant and fill the operating chambers with 8-10 cm^3 of alcohol-glycerine fluid (30 per cent of alcohol and 70 per cent of glycerine).

Fill the operating chambers of the L.G. and flap jacks with 15-20 cm^3 of alcohol-glycerine fluid, then retract and extend the L.G. preventing alcohol-glycerine fluid leaking through the L.G. discharging valve holes from getting on the instrument panels.

5. Dismantle the wheel tyres and inspect the tubes and tyres for condition.

AFTER EVERY 100 LANDINGS.

1. Carry out the same maintenance operations as after 50 landings.

2. Check the L.G. brace struts, L.G. "up" locks and lock strut hinges for clearances(see section L.G. maintenance operations").

25X1

SE[redacted] 25X1

3. Remove the L.G. wheels, inspect the bearings, wash [redacted]m and coat with HK-50 lubricant. Check the brakes [redacted] 25X1 [redacted]otioning and air pressure when braking. If [redacted]essary, adjust the ПУ-6 control valve outlet air pres[redacted]e up to 8 kg/cm^2 by means of the adjusting screw on [redacted]e ПУ-6 box.

4. Check the shimmy damper levers for freedom from [redacted]y.

5. Check the L.G. shock struts for proper air pres[redacted]e.

AFTER EVERY 500 LANDINGS.

1. Carry out the same maintenance operations as [redacted]er 100 landings.

2. Disassemble the L.G. "up" locks, wash them with [redacted]osine, inspect and coat them with ЦИАТИМ-201 [redacted]ricant and reassemble them.

3. Remove and disassemble the L.G. wheels with bra[redacted] and replace brake expander tubes.

4. Remove and disassemble the air system emergency [redacted] flap control valves, inspect their cases, springs and [redacted]de valves for condition; cover the inner surfaces of [redacted] cases with thin coating of technical vaseline and then [redacted]mble the valves.

AFTER EVERY 1000 LANDINGS.

1. Carry out the same maintenance operations as after [redacted] landings.

2. Remove the shock struts, disassemble them and re[redacted] the sealing washers and worn out parts.

3. Remove and reassemble the L.G. and flap operating [redacted].

4. Check the landing gear, braking system and shimmy [redacted]r for correct operation.

[redacted] 25X1

[redacted] 25X1

5. Check the main L.G. "up" locks under a load of [redacted]ied to the lock hook (in this case the lo[redacted] 25X1 open.)

5. SPECIAL EQUIPMENT MAINTENANCE.

Maintenance operations consist in preventive inspections and periodic operations which are carried out to check the equipment for condition, find and remove defects, prevent and decrease excessive wear, prolong the item service life and maintain the equipment to meet the requirements.

PERIODIC MAINTENANCE OPERATIONS OF RADIO EQUIPMENT.

After every 10 hours' flying (but not less than once a month):

1. Carry out the maintenance operations specified for after-flight inspection of the radio equipment.

2. Check the shock mounts for condition and security full amplitude of the units vibration limited by the k mounts.

3. Check the cable shielding for condition and ensure the cables are securely anchored. Inspect the bonding the radio equipment units and cables.

Check the shielded cables for freedom from friction alternative contact.

4. Remove dust, dirt, oil and moisture from the units the radio equipment.

5. Check functioning of the aircraft radio equipment all modes of operation.

6. Measure the level of the electrical interference ated by the engine ignition system when the engine .

7. Check the switches, regulators and buttons for r functioning, the plug connections and two-pin for secure connections, the radio set tuning mecha for security of locking and free movement.

[redacted] 25X1

SEC [redacted] 25X1

8. Check the antenna for security of attachment.

[redacted] nspect the ПО-250 inverter for condition. Che[redacted] 25X1
or fittness to the commutator and free movement.
k brushes for wear and the commutator for condition.
ase of sparking remove the ПО-250 inverter, remove
shes, wipe the commutator with clean cloth damped with
oline, clean the slots between the commutator seg-
ts and remove the carbon dust.

10. Check the helmets. Ensure that the cords and
ir connection with plugs are serviceable and also that
cord connection contacts are clear.

AFTER EVERY 25 HOURS' FLYING.
(but not less than once every three months).

1. Carry out 10-hour periodic maintenance operations.
2. Inspect the plug connections and, if necessary,
an the contacts.
3. Inspect APK-5 A.D.F. tuning shafts for condition,
ove dirt and cover the shafts with a light coating of
se.
4. Check the paiting of the glass panel which covers
APK-5 A.D.F. loop antenna.
5. Cover the pulsmotor parts (dogs with springs,
het wheel teeth, and stop springs) of the radio
smitter and receiver with a light coating of
ТИМ -201 lubricant.
6. Check the helmets for condition and the telephone
throat microphone plugs for security contacts.
7. Check the radio set channel selector buttons for
ition.
8. Check the antenna feeder and plug connectors
condition.
9. Disconnect the ПО-250 inverter ground wire, clean
terminals and reconnect the connections.
10. Check all the radio valves for burning-out of
filament and ensure that electrodes are not short-
uited. Check the emission current and transconduct-

[redacted] 25X1

SECRET

[redacted] 25X1

...eak the valves for security of attachment in the valve
[redacted] ...re that the contact pins are clean and 25X1

AFTER EVERY 50 HOURS' FLYING
(but not less than once every 6 months).

1. Carry out 25-hour periodic maintenance operations.
2. Check the following characteristics of the APK-5 ...F. for meeting the specifications:
- receiver sensitivity,
- calibration accuracy,
- sensitivity at homing and bearing.
Check the parts and wiring for condition.
3. Remove the APK-5 A.D.F. tuning shafts, wash them, ...e dry, inspect the casing and parts for condition, ...inge the "Л" turbine oil into the casing, cover the ...ing surface with a light coating of lubricant and ...ssemble the tuning cables.
4. Check the relay terminals of the radio set sele- ... rectifier ("B" unit) for condition. If the relay ...tacts are slightly burned wipe them with cloth dampened ...h gasoline. If the contact are severely burned clean them.
5. Check the main electrical parameters of the СШ-2 ...rphone;
- throat microphones supply voltage (3-4 volts)
- average speech voltage (not less than 50 volts).
6. Remove the ПО-250 inverter, remove brushes, wipe ... clean the commutator and the slots between the commu- ...r segments. In case of the commutator beating, excessive ... and other damages replace the inverter. Blow out the ...erter with compressed air, check the brush holders for ...dition and the spring for damage, tension and security ...ttachment. Check the brushes for wear, fitness to ... commutator and free movement in the brush-holders. ...ve the cover of the inverter filter and inspect the ...s and filter wiring for condition at the receptacles. ...ve the bearing cap, remove old lubricant, wash with ...ine, blow out with compressed air and fill with ... lubricant. Install the inverter and connect the ...ing strips.

SECRET

25X1

AFTER EVERY 100 HOURS' FLYING

(but not less than once a year). 25X1

1. Carry out 50-hour periodic maintenance operations.
2. Remove housing from the APX-5 A.D.F. loop antenna and inspect the slip rings. If necessary wipe the [illegible].

EVERY 3 MONTHS IRRESPECTIVE OF THE NUMBER OF FLYING HOURS.

1. Check the shock mounts for condition and replace if damaged.
2. Check the throat microphone for air tightness measure the resistance. Check the telephone [illegible] for adjustment.

[illegible] 6 MONTHS IRRESPECTIVE OF THE HOURS FLOWN.

1. Perform the general inspection of the radio set
2. Check the characteristics of the radio set for [illegible] the specifications:
a) for transmitter:
- [illegible] current,
- percentage modulation,
- [illegible] frequency,
- [illegible],
- [illegible],
b) for receiver:
- [illegible],
- [illegible],
- [illegible],
- [illegible],

25X1

SECRET

[redacted]

[redacted]

25X1

25X1

IC MAINTENANCE OPERATIONS OF ELECTRICAL

EQUIPMENT.

AFTER EVERY 10 HOURS' FLYING.

1. Examine the generator for damage and security, dust, dirt and oil.

2. Inspect the aircraft battery and check:

a) the batteries under a load (the voltage should less than 24 v.);

b) the insulation of the outlet wires and see that tainer is dry, dry it if necessary;

c) the electrolyte level in each cell, the level be not less than 12 mm. over the plates and not the safety level cover;

d) the vent plugs for cleanliness and the valves per functioning. Wash with clean water and dry plugs if necessary, slightly pull off the

the compound for detection of cracks; neutralize aline solution, wash with clean water and wipe surface.

Dry the battery, remove corrosion from the terminals, tightening the cover and lugs. After attaching the ect the terminals, cover screws and cell connectors thin layer of technical vaseline.

Examine the cables shielding, check the shield for damage and check that the separate parts of the are securely connected to each other and to the control device. Remove damages if any.

Check the electrical equipment for proper functio ensure the required accompliance.

[redacted]

25X1

AFTER EVERY 25 HOURS' FLYING.

t not less than once every three months).

1. Perform a battery check cycle (in accordance with service instruction of the aircraft storage batteries). the container (heat insulation), remove corrosion from fuse box and the battery plug connecter.

2. Check that the contacts of the power supply control and circuit breakers panel are in good condition and re.

3. Check the terminal nuts in the terminal section of generator control box for tightening, and the locking s or spring washers for presence.

Check the leads of the filter for security of attach-t. Check the coupling nuts of the cables for secure nection and cleanliness. Check the contacts of the rload and reverse current relays and voltage regulator condition; clean if necessary. Open the relay sec-n for performing the periodic maintenance operations y of those control boxes which guaranteed service life expired.

4. Examine the commutator-brush assembly of the 50 inverter, check the brushes for fitness to the com-tor and free movement in holders; blow brush dust out the inverter with compressed air.

5. Check the contacts of the plug connectors and cab-for cleanliness and security. Make sure that the bond-strips are secure; disconnect the bonding strips, clean contacts and connect them again.

6. Open the switch panel, remove moisture, dust, dirt corrosion. In dry weather leave the panel open for hours, and then remove dust by blowing. Open the fuo-boxes and clean them.

7. Inspect the shielded parts of the electrical m: check the shielding braids for damage, cleanliness secure connection to the aircraft common ground.

8. Check the switching devices: switches (including the limit switches), selector switches, buttons, rheostats for security of attachment and proper functioning. Check the circuits switched on by the rheostats for short circuit.

9. Check the open-circuit current of the ПАГ-1ФП inverter (it should not exceed 24 A.).

AFTER EVERY 50 HOURS' FLYING.

(not less than once every six months).

1. Perform 25 hours periodic maintenance operations of the ПО-250 inverter. Measure the wear of the brushes, wipe and clean the commutator and slip rings, clean the slots between the commutator segments. Replace the brushes worn to 10 mm.

2. Check the П-1 resistance bulb winding for resistance (at 0°C - 0.1±0.15 ohm, at 100°C -129.8±0.5 ohm).

3. Check the generator in conjunction with the generator control box and the battery for proper functioning in accordance with the generator control box periodic maintenance operations.

4. Repair the heat insulation of the battery container, fit closely the container covers. Remove corrosion from the metal parts: repair the wire in the container; repair the containers of the ground batteries.

5. Check the operation of the generator control box in conjunction with the generator and the battery for the following parameters:

- voltage closing the contacts of the reverse current relay and check the generator r.p.m.;
- voltage opening the contacts of the reverse current relay and the value of the reverse current;
- adjustable voltage range within upper and lower limits at the generator r.p.m. under the nominal electrical load;

- current when the overload relay actuates.

If measured values do not meet specifications given in the certificate, the relays should be adjusted.

6. Check the voltammeters for accurate readings, check the leads to the ammeter shunt for secure attachment.

7. Every 150 switchings-on clean the contacts of the КП-4716 booster coil with a file.

8. Check the commutator and the brushes of the ПАГ-14П inverter for condition, replace the brushes worn to 10mm, blow out the inverter with compressed air, measure open-circuit current.

PERIODIC MAINTENANCE OPERATIONS OF INSTRUMENTS.

AFTER-FLIGHT INSPECTION.

1. Check the АГИ-1 artificial horizon for correct functioning according to the instrument certificate, paragraphs 1 and 2, section 2.

2. Inspect visually all the instruments. Check that the readings of the barometric dial of the altimeter is equal to the sea level pressure at given moment. Check the altimeter knobs for proper functioning.

3. Inspect the pitot static tube, clean the water drain holes with a brass wire.

4. Check the instruments and inverter for security attachment, compasses brackets for security, compass light and АРК-5 A.D.F. control panels light for functioning, plug connectors for secure connection, turn-and-bank indicator for correct location of the pointer.

5. Check the indicators, thermocouple and compensating leads of the ТЦТ-13 cylinder head thermometer for secure attachment, insulation of connections for security.

AFTER EVERY 10 HOURS' FLYING.

1. Check the pressure gauge transmitters and thermometer bulbs of the ЭМИ-3К engine gauge unit, thermocouples of the cylinder head thermometer, carburettor air inlet thermometer bulb for secure attachment and locking. Check hoses of the ЭМИ-3К for condition, secure attachment and locking.

SECRET

25X1

2. Check the tachometer flexible shaft for secure attachment, and for getting oil into the casing. When 25X1 it happens remove the flexible shaft, wash it with kerosene, dry it and grease with the HK-50 lubricant.

3. Check the pitot static tube heating.

4. Drain the condensate from the water traps of the pitot static tube pipeline.

5. Wipe carefully dirty lables and fluorescent signs on the control levers with clean cotton-wool dipped in gasoline.

ONCE EVERY 3 MONTHS.

1. Check the АГИ-1 artificial horizon for correct functioning according to the instrument certificate, paragraphs 1,2,3,4,6,7a,8a,10a,section 2.

2. Remove the air speed indicators, altimeters and rate-of-climb indicators from the aircraft and check them in accordance with the certificates for:

- airtightness of the cases,
- main errors,
- reading variations,
- unsmooth movement of the pointers.

3. Remove the static and dynamic pressure pipelines from the instruments, open the water traps plugs (or remove the water traps), remove moisture out of them and blow them out with compressed air under the pressure of 0.5-1 atm. Connect the pipelines and check the system for airtightness.

Remove the cap of the pitot static tube and inspect visually the heater coil, clean the corrosion from the contact rings. Check the heater current consumption.

4. Check the air pressure gauge for errors and hysteresis (reading variations) and test it under the pressure of 90 kg/cm^2 within one minute.

5. Remove the ТЭ-45 tachometer flexible shaft, disassemble, wash it with kerosine and dry; if the shaft is still serviceable, grease, reassemble and install it again.

6. Check the fuel contents gauge transmitters and indicator for the calibrating error at the temperature 20±5° according to the instrument certificate.

25X1

SECR

[redacted]

[redacted] 25X1

7. Check the ЭУ-48 solenoid valve (when it does no[redacted] for air leakage under the pressure of 0 to 70kg/cm^2.

25X1

ONCE EVERY 6 MONTHS.

1. Check the cover of the pitot static tube for condition, remove the pitot static tube from the boom, check the hoses for condition, check that there are no cracks in the places of the soldering of the pipe connections to the pitot static tube casing.

2. Check the electrical system insulation for resistance and the instrument wiring for condition.

3. Check the fuel contents gauge for reading error according to the calibration card and the indicator for reading error with the help of the resistance box.

4. Check the КИ-12 magnetic compass for value of the compass self-deviation (it should not exceed ±2,5°) at 0°, 90°, 180° and 270° with the compensator in neutral position.

5. Check the stagnation angle of the КИ-12 compass card deflection through 5° (the stagnation angle does not exceed 1° before tapping and 0° after tapping).

6. Check the transmitter interphase voltage of the [illegible] tachometer by the ТЭ-45 tachometer indicator at 30[illegible] r.p.m. between the terminals 1-2,2-3,1-3 (28-32 volts in e[illegible]e). Check it in conjunction with two indicators.

7. Check the transmitters and indicators of the [illegible] gauge unit for reading error.

8. Check the ТУТ-13 cylinder head thermometers and ТЭ-45 tachometer indicators for main error after it subjected to the vibration load of 0,1-0,3 g. or [illegible]ing.

9. Check the ТУЭ-48 thermometer for error.

10. Check the МВ-16 boost gauge for error, reading [illegible]tion (hysteresis) and smooth movement of the pointer [illegible] the static line for air tightness.

The checking of the reading variations and smooth [illegible]ement of the pointer is performed at continuous [illegible]es from 0.1 to 0,3 g.

[redacted] 25X1

V. AIRCRAFT A[redacted]

[redacted] 25X1

I. WING CENTER SECTION MAINTENANCE.

When performing the wing center section maintenance operations, proceed as follows:

check the wing center section-to-outer panel attachment fittings L.G. shock strut hinges, riveted seams (in case of loose rivets, replace them) for condition;

check the fuel tank cells access doors for security;

check the oil cooler air intake and duct shutter for condition.

2. FUSELAGE MAINTENANCE.

When performing the fuselage maintenance operations, proceed as follows:

1. Inspect the fuselage-to-wing center section and tail unit attachment fittings, engine mount fittings, check the canopy sliding parts for condition. Inspect the bracing wires and welded fittings. Protect the canopy sliding parts from deformation.

2. When performing the maintenance operations, prevent solvent (dichlorethan, acetone, ethyl alcohol, aviation gasoline etc.) from getting on the canopy glazing; wipe the window panels only with clean, soft cloth(baise, chamois, flannel).

3. WING OUTER PANEL MAINTENANCE.

When performing the wing outer panel maintenance, proceed as follows:

Inspect the attachment fittings and the bolts of the attachment fittings for condition; check the aileron on the wing outer panel for clearance, lubricate the aileron hinges and inspect the aileron balance tab for condition.

When removing the wing splice strip, protect it from deformation. Remove the strip after the turnbuckle, tightening on the strip, and the loop, connecting the strip to the fitting of the L.G. main strut wheel are disconnected.

[redacted] 25X1

4. TAIL UNIT MAINTE[redacted]

When performing the tail unit maintenance, pay attention to the stabiliser and fin-to-fuselage attachment fittings, the bracing wires and brace struts attachment fittings, the elevator and rudder hinges, the elevator and rudder control bell cranks, lubricate the hinge joints, protect the hinge joints from wear, distortion and cracks, protect the rods and bell cranks from corrosion, check all the fittings for locking and security of attachment.

Protect the bracing wires from dents and corrosion. The wires which are not coated with transparent varnish, should be covered with protective lubricant.

5. FABRIC SKIN MAINTENANCE.

The fabric skin maintenance consists in its protection from mechanical damages, in washing and cleaning of its external surfaces and inspection of varnish coating.

To keep varnish coating in good condition, proceed as follows:

1. Keep the aircraft clean.

2. After every flying day, remove soot and oil spots from the skin with clean rags dampened in 3% solution of soap in warm water and then wash the skin with clean water. After washing, wipe the skin dry.

VI. LANDING GEAR AND FLAP MAINTENANCE.

1. LANDING GEAR MAINTENANCE.

When in service, see that the L.G. hinge joints are clean and function reliably, lubricate the hinge joints and fill [illegible] lubricant with graphit into the grease [illegible] the L.G. "up" lock jacks and the L.G. [illegible]

[illegible] the main L.G. shock struts, check [illegible] for locking, check the collar connecting [illegible] hydraulic cylinders for security and locking, [illegible] check trunnion joints and ball hinges for condition, [illegible] the teeth couplings of the shock strut [illegible] excessive, remove the play by tightening

SECRET

The shock strut lateral [redacted] 25X1
measured at the wheel axle should not exceed 3.5 mm. [redacted] 25X1
[redacted] checking the play, see that at the strut extreme positions (on account of play) clearance between the bracket lug and the "up" lock hook should not be less than 0.5 mm. Clearance between the bolt and hook out-out should be within a range of 1-3 mm. Clearance at the brace strut joint points should be within a range of 0.5-0.3 mm; the clearance can increase by 0.2 mm. on account of play in the joints and in the jack ball-type locks; if the clearance exceeds these limits, readjust the jack rod travel (by means of the rod fork bolt).

Clearances in the L.G. jack ball-type locks should be within 0.2-0.5 mm limit. If the clearance exceeds these limits, decrease it by machining the outer surface of the tapered ring Fig.13 (8).

The L.G. shock struts are charged in summer as well as in winter with AM-70/10 fluid (70% of glycerine,10% of water and 20% of alcohol, by weight).

The quantity of fluid in the main shock strut is 270 cm^3. Fluid is fed into the main shock strut through the hole of the charging valve connection.

The shock strut should be in the vertical position. In this case the quantity of fluid reaching the level of the charging connection hole is 270 cm^3.

If [redacted] the shock struts are filled with working fluid, charge them with air. To do this, screw the pressure reducing device on [redacted] charging connection and charge the shock [redacted] with air up to 20 kg/cm^2 through the pressure reducing device.

Upon inspecting the nose gear, check the attachment bolts for locking, pay particular attention to the strength [redacted] of the shimmy damper and torque links; check the ball inserts in the brace strut-to-shock strut attachment [redacted] for condition; [redacted] play of the L.G. recessed [redacted] there can be a play in the hinge; if the play [redacted] 0.5 mm., replace the insert.

Check the nose wheel self-centering mechanism for [redacted]

[redacted] 25X1

The wheel from the extreme position should be set in position for 10 sec.

If the time required for the wheel returning to the neutral position exceeds 10 sec, it means that friction in the shock strut sealing washer set has increased.

In this case loosen the washers or reassemble the sealing washer set of the shock strut.

The quantity of fluid in the nose gear should be 420 cm^3.

With the shock strut in the vertical position, fill the shock strut with fluid up to the charging connection level and charge it with air up to 17 kg/cm^2.

The shock strut lateral play on the suspension bolts measured at the wheel axle should not exceed 3 mm.

When checking the play, see that the clearance between the torque links lugs and hook of the L.G. "Up" should be not less than 2 mm.

Clearance between the torque links bolts and hook cut-out should be within a range of 2-3 mm.

Clearance in the brace strut joint points should be within a range of 0.05-0.3 mm; the clearance can increase by 0.1 mm on account of plays in the joints and ball-type lock of the L.G. operating jack.

When replacing the shimmy damper, drill the shimmy damper lever spline to insert the lever hold-down bolt in case the holes do not coincide.

Should the fluid leak from the damper cover, replace the sealing gasket.

Should the fluid leak from the damper into the [illegible] bearing, change the rubber ring.

Charge and recharge the damper with alcohol-glycerine fluid(50% of glycerine, 35% of alcohol and 15% water, by weight) heated up to 47°C.

Prevent air from getting into the shimmy damper.

25X1
25X1

[redacted]. OPERATING PROCEDURE AND CHECK OF THE COMPRESSED AIR SYSTEM FOR TIGHTNESS.

1. Raise the aircraft by means of the trestles so that the landing gear can move freely.

2. Move the L.G. control valve to the "Down"position, check the pressure in the air system, check the system for air tightness under a pressure of 45-50 kg/cm^2 for 10 min; pressure drop should not exceed 1.5 kg/cm^2, with the air system valve being closed.

3. Move the L.G. control valve to the "Up" position, check the air system for tightness, then set L.G. control lever in the neutral position.

Extend and retract the L.G. at back pressure. To do this when extending the L.G., move the control lever from the "Neutral" position to the "Up" position and keep so for 2-3 sec, then move the lever from the "Up" position to the "Down" position.

When extending the L.G., check the warning system for correct functioning.

Mechanical position indicators should fully project up through the skin (the indicator fourth mark should be at the skin level).

The L.G. should be freely extended or retracted at a pressure of 25 kg/cm^2 in the air system.

When retracting or extending the L.G., check the L.G. lock jacks rods for free movement.

While on the ground, check the L.G. emergency extension [illegible] at air back pressure.

To do this:

1. [illegible] L.G. control valve in the "Up" position.

2. [illegible] L.G. emergency extension valves and set the L.G. control valve in the neutral position; check the L.G. [illegible] position by the L.G. position warning device.

[illegible] condition extend the L.G. while on the [illegible] back pressure.

25X1

[redacted]LAP MAINTENANCE [redacted] 25X1

In operation inspect the flap, its hinge and shock absorber. For lubricating the collar apply 15-20 grs of the alcohol-glycerine fluid to the flap-operating jack.

Should scratches and cracks occur in the flap hinge, replace the hinge. If the rivets on the flap are loosened, tighten or change them.

The flap is controlled by a valve:
to extend the flap, move the valve lever from "neutral" to "retracted" position, then passing-by the "neutral" position set the lever in the "extended" position and keep it there till landing is completed.

After retracting the flap, set the valve lever in the "neutral" position.

4. WHEELS AND PNEUMATIC SYSTEM MAINTENANCE.

Prevent fuel and lubricants from getting on tyres, keep them clean and covered. When carrying out the engine periodic operations, cover the nose wheel.

Prevent the pneumatic system pipeline wear and damage, drain condensate timely.

Prevent moisture and dirt from seeping forward into the system when charging and check the pipeline and units for security of attachment.

After the aircraft was idle for 15 or more days apply 15-20 cm^3 of the alcohol-glycerine fluid (30% alcohol and 70% glycerine) to the operating chambers of the L.G. and flap operating jacks and 5-10 cm^3 of the same fluid to the L.G. lock cylinders;
[illegible] the L.G. and flap for extension and retraction from [illegible] by operating the main and emergency systems.
[illegible] the L.G. valve drain holes with clean rags be[illegible] the instrument panels from the alcohol-glycerine [illegible]

[illegible] between the nose wheel inflating valve [illegible] and the axle strut fork should be not less [illegible] them. When changing the wheel (or tyre) [illegible] tightening valve cap and off.

[redacted] 25X1

SECRET

VII. AIRCRAFT CONTR[redacted] MAINTENANCE.

[redacted] inspecting the aircraft control system, check [redacted] and aileron skin for condition, ensure that the control stick (hand wheels, pedals) movement corresponds to angular movement of the elevators, ailerons and trim tabs and examine the stops for condition.

When inspecting the cable control system, check the cables for condition, cleanliness and security of attachment, the turnbuckles for locking, pulleys for condition and cleanliness, cables for tension.

The cables should be pulled up so that the pulley over which the cable runs should be rotated by a slight hand force and when the control system operates (i.e. when the cables move) the pulleys should be rotated by cable movement.

When inspecting the rod control system, clean and lubricate all units and parts of the system, prevent the hinge joints, pulleys, bearings from wearing, prevent the rods and bell-cranks from destortion, do not overtighten the bearing axles and hinge joints, examine systematically all the units for security of attachment and locking.

VIII. POWER PLANT MAINTENANCE.

[redacted] inspect the cowls and shutters, [redacted] clearances between the cowling and the cowl [redacted] edge by unscrewing forks from the shutters [redacted]

[redacted] the cowl hinges for damage; see that the [redacted] do not contact the cowl. When inspecting the [redacted] shutters, check the shutter discs attachment and the [redacted] locking for security; check the moving ring [redacted] guides on the stationary shutter disc for [redacted] the shutter control bracket-on-moving disc [redacted] for security; check the moving disc bolts [redacted] bell cranks oval holes for excessive wear.

25X1

SEC [redacted] 25X1

[redacted] 25X1

When inspecting the B-530 propeller:

1. Check the propeller hub for looking and freedom from cracks and dents.

2. Check the blade tipping for freedom from bulging, cracks, breaks and projecting of rivets.

3. Check the blades for condition. Their coating should be uniform and smooth. Blades with long and deep longitudinal cracks and play in the shank are not to be repaired and must be replaced.

4. Check the blade for freedom from angular displacement in the hub barrel.

The arrow on the blade should conicide with the centre division of the scale on the barrel end.

When tightening the screw on the engine shaft front end, do not place a trestle or a ladder under the blade tips.

Hold the blades by hands.

Particular attention should be given to the blade leading edge, which can be easily deformed under local [illegible] and shocks.

When the aircraft is inoperative, set the propeller in horizontal position and put a cover.

When preparing the propeller for mounting on the engine, thoroughly clean it and remove the protective lubricant; inspect the splines of the propeller shaft and remove the protective lubricant; clean the splines and cover them with a light coating of vaseline.

When servicing the engine controls, check the [illegible] for sagging and free movement; check the ball [illegible] for freedom from play; prevent the control cable [illegible] and their excessive tightening in points [illegible] prevent disadjustment of the screws on the [illegible] for cracks.

When servicing the carburetor air [illegible] and [illegible] set the clearance between the [illegible] which is 2 to 3 mm.

[redacted] 25X1

SECRET

25X1

During operation c[redacted] starting system for tightness, pipe lines for 25X1
good condition and fuel starting valves for proper functioning.

Check the primer for leakage and periodically inspect its gland.

Every time after using the primer lock it by turning the plunger handle in the direction of flight (the plunger being in the down position).

When intalling the fuel tanks see that the straps and lining under them closely fit the tanks.

See that the tank attachment straps and tanks are not contact and damaged by the stiffeners of the fuel tank cell access doors.

Check the pipe lines for chafing and friction against the aircraft elements and units.

Pay particular attention to the pipe lines, running from the fire wall to the engine, as they are located in the area of high vibration.

Tighten the nuts only if loose or in case of leakage.

If leakage does not stop when tightening a nut, disconnect the connection, wash and wipe the thread with dry and clean rags, cover it with a light coating of lubricant, reassemble the connection and test it again.

Do not tighten the nuts excessively as it will result in seizing of contacting parts.

See that the pipe lines painting is not damaged. Restore the painting if damaged.

If metal chips are found in oil filter, investigate the reason for it.

To do this, drain the oil pipe line, wash the [illegible] with gasoline, wipe them with dry rags and ins-

[illegible] attention should be given to the pipe [illegible] connections; file scores and scratches, if any. [illegible] the pipe lines, oil tank and oil cooler not [illegible] and when changing the engine.

25X1

[redacted]

SECRET

25X1

When performing the maintenance operations on the ignition system, see that the H.T. wires are not spliced 25X1

After two years' operation, when overhauling the engine, change all the H.T. wires. See that the ПМ-1 ignition switch terminals and contact are free from burning, dirt and oil.

Wipe the contacts and terminals with rags dampened in gasoline, if necessary.

The ПМ-1 ignition switch general faults are: damaged or loose contacts. Should the selector switch fail, change it.

X. MAINTENANCE OF SPECIAL EQUIPMENT.

MAINTENANCE OF CABIN EQUIPMENT AND INSTRUMENTS.

To provide reliable operation of the instruments during the operation perform all the periodic maintenance operations in time and do as follows:

1. Ensure that the instruments installed on the aircraft are securely attached. Check ЭМИ-3К engine transmitters and ТУ3-48 carbureter air inlet temperature gauge for locking.

2. Visually inspect the instruments for cracks and broken glasses. Ensure that the instruments are deflected from the initial positions within the tolerances. The knobs and cage knobs of the instruments should operate reliably, if they fail to operate, disassemble and repair in accordance with the instructions or replace them with new instruments.

3. Periodically inspect the plug connections of the instruments for condition.

If there are any poor contacts or if the contacts are damaged, take measures to eliminate the defects and clean the contacts.

4. Check the instruments for proper operation periodically, removing them from the aircraft 25X1

5. Check the shock-absorbers of the instrument board [illegible] panel for condition. If the shock-absorbers are [illegible] repair or replace them.

6. Check the instrument boards and control boards for cleanliness. Clean them periodically, removing dust, dirt, oil etc. The quadrant levers should be securely attached in the brackets and at the same time the lever movement should be smooth without seizing.

7. Check the piping of the aircraft instruments for condition and the bolt joints and hoses for security. In case of dents and cracks in the pipe lines replace them. Remove the defects of the bolt joints and hose connections.

8. Check static and dynamic pressure pipe lines of the Pitot static tube for security of attachment, remove the noticed defects.

9. Do not connect the pressure gauge to the air system by turning the instrument body. Do not use the pressure gauge in the air system, the operating pressure in which is more than 50 kg/cm^2. Open the valve smoothly.

10. Check the fuel and oil pressure transmitters of the [illegible]-3K engine gauge and their pipelines for tightness. Check the bodies of the fuel contents gauge transmitters and the floats for tightness. Ensure that there is no fuel leakage in the transmitter potentiometer chamber.

11. Periodically check the instruments for reading adjusting according to the instrument technical descriptions and the aircraft periodic maintenance operations.

12. Particular attention should be given to the luminous [illegible]. Do not touch luminous labels by hands to [illegible] clean. Dirt luminous labels and luminous rings [illegible] lever should be carefully wiped with [illegible] in vaseline.

25X1

MAINTENANCE OF ELECTRICAL WIRING, ELECTRICAL AND RADIO EQUIPMENT.

25X1

The aircraft electrical system is provided with БПВЛ wires, which are bundled in wire harnesses. The polychlorvinyl sleeves threaded on the wire terminals are identified by letters and numbers, which are written by special ink.

The first letter of the marking is the symbol of the group of equipment, the second one- the power consumer and the number - the circuit.

For example: a) marking ОФ5 means as follows:

О - lighting /group/

Ф - landing light /consumer/

5 - circuit

b) marking ЭГ 1 means as follows:

Э - supply source

Г - generator

1 - circuit

To prevent the electrical equipment from defects periodically inspect the insulation and contacts and keep them free from moisture.

As soon as possible in good weather open all hatches, pilots' cabin canopies and electrical panels for drying, remove moisture, dirt and dust with a clean, dry cloth. When drying carefully inspect all the electrical system, paying special attention to the terminal connections and junction blocks. Check contacts for security.

[illegible] contacts (corrosion, poor contacts etc.) [illegible] and damaged wire insulation (wear, small [illegible].

[illegible] the contacts with current-carrying [illegible] coating (zinc, tin) tighten them [illegible]

[illegible] surfaces without corrosion-resisting coat[illegible]

[illegible] the contact [illegible] and cover with [illegible] technical vaseline. Tighten the cap[illegible] [illegible]. Cover the [illegible] with [illegible] varnish or enamel.

SECRET

Damaged circuit breakers [redacted] 25X1

[redacted] maintenance operations. 25X1

When inspecting the bonding system, see that the bonding strips are securely attached. When removing, assembling and diassembling prevent the bonding strips from breaking.

When mounting the units ensure that the bonding strips are securely attached.

WARNING: When connecting separate circuits via the circuit breaker, operate the switch with quick movement and release the lever to prevent the circuit breaker from burning out at overloading or short circuit.

INSTRUCTION

FOR P-800 RADIO SET TUNING.

CAUTION: [illegible] operating the radio set:

1. Do not rotate the locked knobs of the switching gear when the channel is "on" without throwing the levers. Should this precaution be neglected the channel switching gear may fail.

2. Do not connect the radio set to the aircraft electrical system, the voltage of which is less than 24,3 v. or more than 29.7 v. and to the system without a battery connected in parallel. Should this precaution be neglected the [illegible]-100 inverter and valves may fail. Remember that the voltage lower than 24,3 v. is as dangerous as that higher than 29,7 v.

3. When replacing the valves do not mix them up. If the [illegible] and the valves of the receiver are mixed up the [illegible] amplifier anode circuits burn out.

4. When wiping or cleaning the relay contacts do not [illegible] supports.

[redacted] 25X1

I. PURPOSE OF CONTROLS

[redacted] 25X1

1. Rectifier ("B" unit).

a) Under the "Power supply switch" name plate is the "MA-100 inverter - a.c. electrical system" toggle switch.

The MA-100 inverter or centralized electrical system can be used as an A.C. supply source. Depending on the source, move the toggle switch to the corresponding position.

In operating position the toggle switch should be closed with the name plate.

b) The extreme right position of the adjustment potentiometer screw corresponds to the MA-100 inverter maximum voltage.

2. TRANSMITTER ("A" unit).

a) Three knobs of the switching gear are designed for tuning (as regards tuning order, see below).

b) Antenna circuit adjusting screw located under the cap near the "min.-max." name plate is adjusted at the manufacturing plant. Do not rotate it during the operation because it may result in decreasing of the communication distance.

3. RECEIVER("B" unit).

a) Two knobs of the switching gear are designed for tuning (as regards tuning order, see below).

b) Setting the sensitivity control knob to the extreme right position corresponds to the maximum sensitivity distance of reception.

c) "Noise Limiter" toggle switch is designed for switching on the noise limiter.

The noise limiter automatically switches off the [redacted] there is no carrier frequency and switches [redacted] when the carrier frequency appears.

SECRET

[redacted] 25X1

SECRET

4. CONTROL PANEL ("[redacted]")

25X1
25X1

a) The channels are changed by means of the channel selector buttons. When one of channels is selected, a white fluorescent shadow appears in the window of the corresponding channel.

On the top of the control panel is a "Release" button. Any button of channel selected on the control panel can be released by pressing this button. But the channels of the receiver and transmitter are not switched off.

b) Turning the volume control knob to the extreme right position corresponds to the maximum volume.

The volume control stop screw prevents the possible interphone output grounding when the volume control is in the extreme right position (in this position the resistance of the volume control is extremely low).

When the interphone is not available or when the position of the volume control does not affect the interphone operation, it is recommended to unscrew the volume control stop screw from the control panel for increasing the volume adjusting range.

c) There is a toggle switch with the "1-2" or "Radio-A.D.F." name plate. The positions engraved "1" or "2" correspond to the operation in conjunction with one or two receivers respectively.

5. MEASURING UNIT ("И")

a) The channels are changed by means of the channel selector buttons.

b) The "Rec.-Tr." toggle switch should be set in the corresponding position according to the mode of operation.

c) The 11 - position selector switch is designed for testing the radio set and measuring current and voltage in the main circuits.

25X1

SECRET [redacted] 25X1

II. TUNING.

[redacted] 25X1 the power supply source provided for the radio set operation when the engine is inoperative to the aircraft electrical system and move the "battery" switch located on the control panel to the "ON" position. The aircraft electrical system voltage should be not less than 24.3 v.

2. Remove the covers protecting the receiver and transmitter channel switching gear and insert required crystals into the sockets. The scale of the "A" and "Б" units are graduated in fixed waves. Tune the radio set in the portion of scale corresponding to the crystal number.

3. Move the "Radio" switch on the electrical panel to the "ON" position (the inverter will start) and wait for 1-1.5 minute till the valves warm up.

TRANSMITTER TUNING.

4. Set the "Rec.-Trans." switch on the "И" unit in the "Trans." position. Connect the Ф-101-201 and Ф-106 [illegible] the "И" unit to the respective sockets of the transmitter. Press the throw button and after releasing the channel switching gear, unlock the tuning knobs by rotating the [illegible] knob 1/2-3/4 revolution counter-clockwise from [illegible]

NOTE: The channel selector buttons on the control panel [illegible] in "OFF" position. [illegible] pressing the button of another channel on the [illegible] unit [illegible] and transmitter parameters will [illegible] [illegible]

[illegible] first channel selector button on the [illegible]

[illegible] selector switch in the [illegible] [illegible] knob of the [illegible] [illegible] indicator. [illegible] the tuning knob [illegible] [illegible]

[redacted]

25X1

[redacted] 25X1

SECRET 7. Turn the selector switch to the "Trans.output" position. Set the second tuning knob according to maximum reading of the indicator and check the scale reading against the [redacted] 25X1 approximate correspondance to the crystal number.

8. Turn the selector switch to the "Antenna"position and set the third knob according to the max. reading of the indicator. Check the scale reading against the knob mark for approximate correspondance to the crystal number.

9. For fine tuning of the transmitter, set the selector switch in the position marked "Grid current" and set two left-hand knobs according to the min. reading of the indicator.

Fine trimming of the transmitter with the selector switch in the "Grid current" position makes the transmitter less affectable to the climatic conditions.

10. When tuning the transmitter, change the channels in the following order: switch on the first channel and tune the transmitter as described above. Then switch on the second, third and fourth channels in succession. Tune each channel of the transmitter following the same procedure as for the first one.

When all the four channels of the transmitter are tuned throw the levers by pressing the throw button.Lock all the tuning knobs one by one, turning the small knobs by the hand fully. Switch on the channels for tuning only beginning from the first channel.

Whenever a required channel is switched ON the channel switch gear will select it in order 1,2,3,4 until the required channel is selected.

If channel "2" is selected and it is necessary to select channel "1" the channels will be selected in order 3,4,1. If channels 3 and 4 were previously tuned they will be mistuned should the knobs be not locked.

Turn the small knobs on the tuning knobs only when the knobs of the channel switching gear are thrown,other wise the channel switching gear may be damaged.

[redacted] 25X1

11. On tuning and locking the knobs, check the [illegible] tuning, i.e. when the selector switch is in
"Tripple", "Trans.output","Antenna" and "Grid current" positions the "И" unit indicator readings should be identical to those obtained at the fine tuning before the knobs were locked.

If the indicator reading for any channel is different, trim this channel.

When trimming one of the channels of the tuned transmitter, first select the preceding channel, throw the levers by pressing the throw button and unlock the tuning knobs, switch on a required channel and tune it as described above. Then throw the levers by pressing the throw button, lock the small tuning knobs of the transmitter and check the readings of the "И" unit indicator when the selector switch is in "Tripple","Trans.output" and "Antenna" positions.

RECEIVER TUNING.

After tuning the transmitter connect Ф-101-201 and Ф-206 plugs of the "И" unit to the receiver and tune it as follows:

12. Set the "Rec.-Trans." switch on the "И" unit in the "Rec." position. Press and then release the throw button and after releasing the channel switching gear, unlock the knobs by rotating the "Lock" knob 1/2-3/4 revolution counter-clockwise from a stop.

13. Switch on the first channel.

14. Turn the selector switch on the "И" unit to the "Crystal" position and set the receiver tuning knob (at the left) according to the maximum pointer deflection at the "И" unit indicator. Check the scale reading against the [illegible] for correspondence to the crystal number.

15. Turn the switch on the "И" unit to the "Grid current" position and set the second tuning knob of the receiver according to the maximum pointer deflection at the indicator. Check the scale reading against the [illegible] for correspondence to the crystal number.

[redacted] 25X1

[redacted] 25X1

16. Trim both tuning knobs according to the maximum [redacted] headphones with the "Noise limiter" toggle [redacted] the sensitivity control knob should be in maximum sensitivity position. Trim the receiver several times by rotating both knobs in turn until the maximum noise in the headphones is obtained.

17. Tune the other channels following the same procedure as for the first one, switching them on in order 1,2,3,4, then throw the levers by pressing three buttons and lock the small tuning knobs by rotating them clockwise to a stop.

18. When tuning the receiver, switch on the channels in the same way as the transmitter channels, i.e. in order 1,2,3,4.

19. Hearing the noise in the headphones, make sure that the receiver is not mistuned after locking the tuning knobs and changing the channels.

Should one of the channels be mistuned, trim it following the same procedure as for the transmitter (see paragraph 11).

20. On tuning the receiver and transmitter, set the "Rec.-Trans." switch of the "M" unit in the "Trans." position (connect Ф-101-201 plug to the transmitter and Ф-106 and Ф-206 plugs - to the transmitter and receiver respectively), put on the headset and, talking into the throat microphone, make sure that the side-tone monitoring circuit is operative.

Then move the toggle switch to "Rec." position and check the operation of the noise limiter.

With the "Noise limiter" in OFF or ON, the receiver noise should be heard or not heard respectively.

Should the noise be heard, rotate the sensitivity control knob in the direction of decreasing till the receiver noise in headphones ceases. But excessive decrease of the sensitivity results in decreasing of the [redacted]

[redacted] the channel switching gear for checking [redacted] for this purpose, switch on the channels [redacted] the noise limiter operation and sensitivity [redacted] each channel. 25X1

[redacted]

25X1

SECRET

22. Disconnect the "M" unit from the receiver and transmitter and cover the channel switching gears with [redacted] ing and free plugs of the receiver and transmitter with caps. After this the radio set is ready for operation. 25X1

The volume control on the control panel should be in the maximum volume position.

23. Check the radio set for communication with another radio station.

24. With the aircraft engine running switch on the "Noise limiter" toggle switch of the "B" unit and be certain that the electrical noise generated by the engine is not heard in the headphones. Should the noise be heard, make as described in paragraph 20.

X. INSTRUCTION ON AIRCRAFT STORAGE.

1. The aircraft should be kept clean, regularly ventilated and covered with dry and clean covers. The propeller should be in horizontal position.

2. When the aircraft is inoperative for an extended period, remove the battery from the aircraft.

3. Before covering the aircraft ensure that:

a) ignition system is "OFF",

b) starting button is locked,

c) L.G. and flap control valves are in the neutral position,

d) the L.G. struts are fully extended.

1. LUBRICANTS USED FOR PREPARING THE AIRCRAFT AND ENGINES FOR STORAGE.

a) for preservation of the aircraft - technical vaseline (for all metal parts not varnish-coated).

b) for inner preservation of the engine, crankcase and cylinders - 52M lubricant; for the fuel pump MK-22 or MK-52 aviation oil, for the pump and carburetor - MK-22 or MK-52 aviation oil;

c) for outer preservation of the engine use 59 [redacted]; 25X1

SECRET

25X1

d) for preservation of the fuel supply system (tanks, [redacted] transformer oil;

25X1

[redacted] the engine in accordace with the AM -14P engine service instruction.

2. AIRCRAFT STORAGE IN HANGAR.

A hangar is the best place for aircraft storing. When storing the aircraft in a hangar the following rules should be observed:

a) the distance between aircraft should meet the requirements of protection against fire;

b) the aircraft placed in hangar should be covered.

3. AIRCRAFT STORAGE IN THE OPEN AIR.

When storing the aircraft in the open air cover it thoroughly, moor it securely, place it before prevailing wind, and place the wheels on wooden plates. Secure the elevators and ailerons with clamps and control levers with a special four-end shock absorbing device.

4. AIRCRAFT STORAGE FOR A MONTH.

1. Preserve the engine for one month.

2. Clean the aircraft from dirt; grease the metal parts not having corrosion-preventive coating with a thin coat of technical vaseline and repair the fabric skin if its paint damaged.

3. Cover and seal the aircraft; hang the plywood label on the cover with the date preserved and the name of a man who preserved the aircraft.

5. AIRCRAFT STORAGE FOR 6 MONTHS AND MORE.

1. Preserve the engine for 60 days using the AM-14P engine service instruction.

2. Re-preserve the engine after every 60 days.

3. Every [redacted] lubricate the L.G. and [redacted] with the alcohol-glycerine fluid.

SECRET

25X1

3. Entries relating to [redacted] operations performed [redacted] in the aircraft and engine Log-books respectively.

4. When storing the aircraft in the open air, inspect the aircraft and engine after rain or sharp changes of temperature, remove moisture, ventilate the aircraft by opening the hatches, remove all the covers from the aircraft and dry them.

6. STORING DISASSEMBLED AIRCRAFT IN SHIPPING BOXES.

1. The depots for disassembled aircraft should meet the requirements for storing finished items.

2. Check the production packing and preservation of the aircraft units to be stored for condition and aircraft units for mechanical damages.

3. Only units and parts which have no traces of corrosion are allowed for storage.

The units and parts which are poorly preserved should be represerved fully or partly.

4. Represervation should be performed at the expiration of the preservation period guaranteed by the Manufacturer and if corrosion is found during the periodic inspection which is carried out as follows:

once in a month inspect - 3-5% of parts; not less than

once every 3 months inspect all the parts.

Before preserving, remove corrosion.

7. STORAGE OF ENGINES INSTALLED IN AIRCRAFT.

In case the engine is not to be operated for a period of more than seven days, preserve it according to the engine service instruction.

SECRET

8. DEPRESERVATION AND PREPARATION OF AIRCRAFT AND ENGINE FOR FLIGHT AFTER EXTENDED STORAGE.

When preparing the aircraft for flight after extended storage, proceed as follows:

1. Remove the covers from the engine cowl, propeller, fuselage, wings and tail unit.

2. With a dry rag remove the lubricant from metal zink - cadinium - and chrome-plated surfaces of the aircraft.

3. Remove protective plugs out of the exhaust and breather pipes.

4. Carry out internal and external de-preservation of the engine according to the service instruction for AM-14P engines.

XI. REASSEMBLING AND DISASSEMBLING THE AIRCRAFT.

The aircraft is reassembled after repair or after shipment by rail or truck.

When joining the parts, do not leave them unattached but, at the same time do not tighten all the attaching bolts fully to prevent one-side tension in the assemblies and parts.

MOUNTING THE WING OUTER PANELS.

1. Select, wash, inspect all the attaching bolts and nuts.

Before mounting, grease the bolts and nuts threading with technical vaseline.

2. Inspect the wing center section and outer panel attachment fittings for condition. Pay special attention to cleanliness of the hole inner surfaces.

3. Prepare the aileron control rods and the Pitot-static tube lines for connection.

SECRET [redacted] 25X1

4. After the prep[redacted] assemblies, bring [redacted] 25X1 uter panel to the center section and carefully insert the wing outer panel attachment lugs into the center-section fork fittings. First insert the upper attaching bolts, then the low bolts, tighten the nuts (uniformly) and secure them with cotter pins, connect the aileron control rods, tighten and cotterpin the nuts and connect bonding strips.

MOUNTING THE AILERONS.

1. Wash the bearings, bolts and aileron hinges, grease them with ЦИАТИМ -201 lubricant.

2. Insert the axle of the hinge on the aileron rib into the hinge bearing, screw on and lock the nut.

Insert the aileron-to-bracket attachment bolt, connect the bonding strips, screw on and lock the nut and then connect the aileron control rods.

MOUNTING THE STABILIZER.

1. Wash and grease the attachment fitting on the fuselage and stabilizer with ЦИАТИМ -201 lubricant. Put the stabilizer on the fuselage, match the attachment fittings, insert the bolts into the front fittings, then into the rear fittings, screw on and lock the nuts. [illegible] the stabilizer is mounted, fasten the brace [illegible]

MOUNTING THE FIN.

1. After inspecting the fin, washing and lubricating the [illegible], mount the fin on the fuselage, [illegible] connect two front fittings, then two rear [illegible] on bolts, screw on the nuts [illegible] [illegible] pins. [illegible] wires, pull them up (within [illegible] [illegible] the tension gauge [illegible]) and

SECRET

[redacted] 25X1

ECRET MOUNTING THE RUDDER [redacted] 25X1

[redacted] grease pins and fittings with technical [redacted] rudder, tighten and cotterpin the low axle nut. 25X1

2. Connect the wires leading to the XC-39 tail navigation light.

3. Connect the cables and bounding strips.

4. Pull up the cables normally, check adjustment and then lock the cable turnbuckles.

MOUNTING THE ELEVATOR.

1. Wash and lubricate all the elevator fittings, bell-crank and trim tab control drum, check the trim tab control drum for correct operation.

2. Insert the pins of the elevator halves into the stabilizer hinge bushings, secure and lock the bolts attaching the elevator halves.

3. Attach the cables to the elevator bell-crank, pull up the cables, adjust the elevator angular movement and lock the turnbuckles.

4. Attach the trim tab control cables and check them for correct operation by actuating the control stick in the cabin and then lock the turnbuckles.

Disassembling of the aircraft is the reverse of assembling.

DISASSEMBLING THE AIRCRAFT FOR PERIODIC MAINTENANCE OPERATIONS.

1. REMOVING THE MAIN L.G. SHOCK STRUTS.

1. Lift the aircraft by means of jacks.

2. Remove the fuel tank cell access door and the [redacted] middle parts of the oval cut-out for the main gear [redacted] strut in the wing center section skin.

3. Disconnect the flexible hoses of the air system [redacted] system wiring from the L.G. operating jack.

[redacted] 25X1

SECRET

4. Remove the bolt attaching the lower arm of the bracing strut to the shock-strut-cylinder bracket.

5. Disconnect the operating jack from the upper arm of the bracing strut and the strut cylinder lever, remove the operating jack preventing the bracing strut from striking the limit switch mounted on the web of rib 3.

6. Remove the bolt attaching the upper arm of the bracing strut to the front spar bracket of the wing center section, remove the bracing strut.

7. Remove the L.G. mechanical position indicator.

8. Disconnect the brake flexible hose from the L.G. shock strut.

9. Remove the taper bolts attaching the shock strut suspension axle to the brackets on rib 3 and 4 of the wing center section.

10. Pull out the shock strut suspension axle using a special wrench and lower the shock strut carefully.

2. REMOVING THE NOSE L.G. SHOCK STRUT.

1. Lift the aircraft by means of jacks.

2. Disconnect the warning system wiring.

3. Disconnect the L.G. operating jack from the upper arm bracket of the bracing strut.

4. Remove the bolt attaching the lower arm of the bracing strut to the shock strut cylinder bracket.

5. Remove the bolts attaching the bracing strut to the [illegible] 1, remove the bracing strut.

6. Disconnect the mechanical position indicator rod [illegible] cylinder lever.

7. Remove the bolts attaching the shock strut fork [illegible] frame "O" and lower the strut carefully.

[illegible] of the L.G. nose and main shock struts is [illegible] of the removing.

[illegible] THE L.G. WHEELS.

[illegible] wheels from the main shock strut half- [illegible] following order:

[illegible] the half-axle nut locking bolt and un- [illegible]

25X1

SECRET

2. Remove the wheel. [redacted]

3. Remove the roller bearing inner cases from the half-axle using a special [illegible].

25X1

[redacted] the wheel pneumatic brake, whose case is attached to the half-axle flange by 6 bolts.

Remove the [illegible]

1. Release air from the tyre [illegible].

2. Pull out the pin locking the [illegible] [illegible]

3. [illegible]

4. Remove the [illegible] flange.

5. Remove the tyre.

Remove the wheel from the nose shock strut in the following order:

1. Unlock and remove the wheel axle nut.

2. Pull out the axle and lower the wheel.

TOWING THE AIRCRAFT.

The aircraft is towed by means of a towing [illegible] inserted into the nose wheel hollow axle [illegible] towing bar fork and by the cable connecting the [illegible] bar fork with the main L.G. shock strut half-[illegible].

Before towing the aircraft, move the L.G. [illegible] valve in the front cabin to the "Down" position. [illegible] the aircraft at a speed of not more than 5 km/h.

MOORING THE AIRCRAFT.

The aircraft stored outside the hangar [illegible] should be securely moored.

[illegible] the rudder, elevator and ailerons [illegible] [illegible] [illegible].

[illegible] -15A aircraft is moored [illegible] [illegible] by the tail bumper skid.

25X1

SECRET

[redacted]

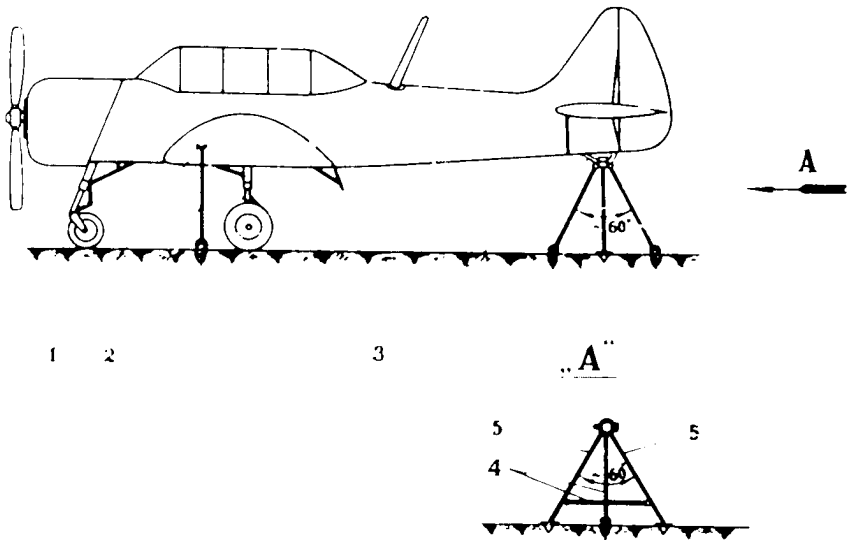


Fig. 30. Aircraft mooring diagram.
1) Wing outer panel front spar lug; 2) mooring cable; 3) tail bumper skid; 4) mooring cables; 5) tubular stakes.

XII. ADJUSTING AND LEVELLING THE AIRCRAFT.

I. ADJUSTING THE AIRCRAFT.

ELEVATOR.

The elevator movement is 25°-1° up and [illegible]. In linear measures the movement of the elevator trailing edge at the cut out for the trim tab is 235-7mm up and 147-7mm down.

When moving the elevator through 25° up, the control sticks in the cabins move backward from the neutral position through 29°30'±30'.

When moving the elevator through 29° down, the control sticks move forward through 46°10'±30'.

SECRET

25X1

RUDDER.

[redacted] 25X1

The rudder moves 27°-1° right and left. In linear measures [redacted] the rudder measured at the lower edge of the balance tab is 294-10mm.

AILERONS.

The aileron movement is 22°-1° up and 15°-1° down. In linear measures movement of the aileron trailing edge measured at the T.E. end of rib 12 of the wing outer panel is 123-5mm up and 84-5mm down.

The aileron trailing edge in neutral position should align with the wing trailing edge. Alignment tolerances should not exceed 2 mm.

The control stick moves 18°30'+30' right and left.

NOTE: Positive limits for the movement of the elevator, rudder and ailerons are not restricted; their applied values are restricted by the limits for the angular movement of the control sticks and pedals.

ELEVATOR TRIM TAB.

In neutral position the trim tab trailing edge should align with the elevator trailing edge.

The trim tab movement is [illegible] up and down.

[illegible] the trim tab trailing edge movement is:

LANDING FLAP.

[illegible] the trailing edge of the retracted flap should be [illegible] surface. The flap moves 30°± [illegible]° down. [illegible] the trailing edge of the flap trailing edge [illegible] from straight section is [illegible]

[illegible] THE STABILIZER.

[illegible] of the stabilizer is [illegible] [illegible] and [illegible] of the [illegible]

[redacted]

25X1

SECRET

25X1

LEVELLING THE AIRC

25X1

aft levelling diagram is given in Fig. 31. The aircraft is levelled to determine accuracy of aligning the main attaching parts after their change or repair.

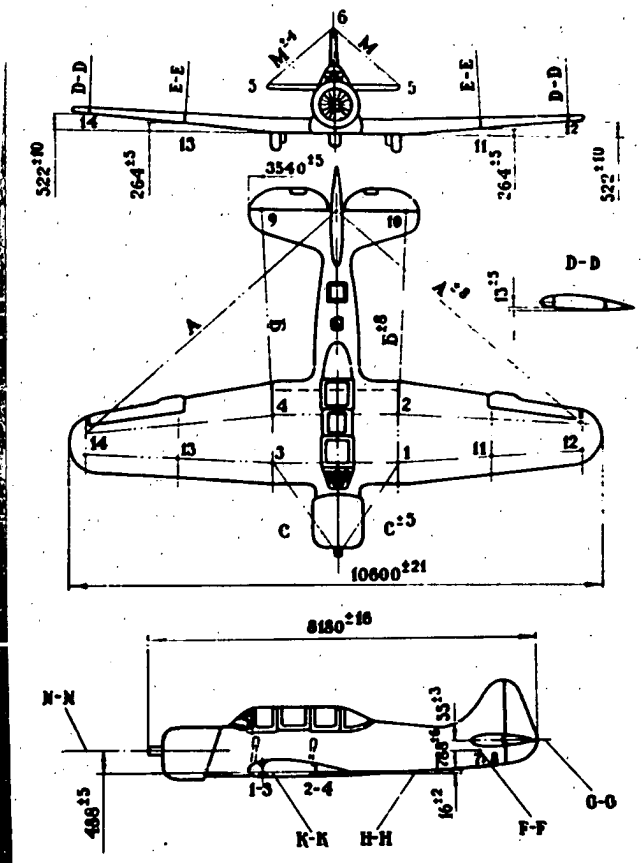


Fig.

D-D

sect

fron

attachment fitting bolts axis; G-G-stabilizer chord; N-N-

center line.

To provide access to the levelling points proceed as follows:

a) remove the tail unit fillet;

b) remove the spike strips;

c) mount the aircraft on two adjusting trestles:

the front spar of the wing center section and the

tail emergency bumper skid.

d) load 70-80 kg weight on the tail bumper skid. Place the air-

craft approximately the level flight position by adjusting

25X1

the ma

Fig. 31. Aircraft - levelling diagram.
D-D-rib No.19; E-E-rib No.12; K-K-reference line wing center section-to-outer panel lower attachment bolts axis at the front spar; H-H-wing center section -to-outer panel lower attachment bolts axis at the rear spar; F-F-stabiliser front attachment fitting bolts axis; G-G-stabiliser chord; N-N-engine centre line.

To provide access to the levelling points proceed as follows:

a) remove the tail unit fillet;

b) remove the splice strips;

c) mount the aircraft on two adjusting trestles: one under the front spar of the wing center section and the other under the tail emergency bumper skid.

Hang a 30-40 kg weight on the tail bumper skid.Place the aircraft in approximately the level flight position by adjusting the trestle height.

SECRET

25X1

[redacted] AIRCRAFT IN THE LEVEL FLIGHT POSITION [redacted]

25X1

Using a level, set the aircraft in the level flight position.

The level is placed aft of the aircraft at a distance of not less than 2m. and 1,5-2m aside from the aircraft line of symmetry. From this position the measurement may be taken for all the levelling points without changing the position of the level.

By adjusting the trestle height set the points 1 and 3 at the same level.

The aircraft is considered to be placed in the level flight position when points 1 and 3 are above points 2 and 4 by 1±2 (points 1,2,3,4 - wing center section-to-outer wing lower attachment - bolts axis).

NOTE: To place the aircraft in approximately the level flight position (when calibrating the fuel gauge etc.) place the level on the canopy side.

LEVELLING THE WING.

The wing levelling is used for checking the wing dihedral and setting angles and wing twist.

CHECKING THE DIHEDRAL ANGLE.

The dihedral angle is checked with the aircraft placed in the level flight position. The wing dihedral angle should be 7°20' and is checked by measuring the elevation of points 11,13 [illegible] 12 and points 14 and 15 to the horizontal line formed by the wing center section. [illegible] the point where it fits to the lower cap of the center section from spar.

[redacted]

25X1

[redacted]

SECRET

CHECKING THE WING SETTING ANGLE AND TWIST.

[redacted]wing setting angle is 2°. Twist is checked by measuring the elevation of the front spar above the rear one at rib 19 of the right and left wing outer panels and should be 13±5mm.

The allowable difference between value measured at the right and left wing outer panels should be not more than 5mm.

LEVELLING THE FUSELAGE.

The elevation of points 7 and 8 above the reference line which passes in the place of the front lower attachment fitting axes should be about 768±6mm.

LEVELLING THE ENGINE AND ENGINE MOUNT.

The elevation of the engine shaft centre line above the reference line, which passes through the wing-to-wing center section front lower attachment fitting axis should be 486±3mm.

The symmetry of the engine mounting is checked by measuring the distances from the engine front section to the points 1 and 3.

SETTING THE STABILIZER.

The stabilizer setting angle is 0°. The elevation of the stabilizer chord above the reference line should be [redacted]mm.

CHECKING THE SYMMETRY.

[redacted] the difference between A dimensions should not [redacted] than 2mm.

[redacted] The difference between B dimensions should [redacted] mm.

[redacted] fin is mounted vertically. The difference [redacted] dimension between points 6 and 7 should not [redacted] 5 mm.

SECRET

SECRET

XIII. THE AIRCRAFT PILOTING

Special equipment installed on the aircraft makes it suitable for day and night flying in good weather conditions.

TAXIING.

The aircraft is stable when taxiing at 15m/sec cross wind.

When taxiing, the aircraft tends to turn to the right which compensated by the rudder deflection to the left.

TAKE-OFF AND CLIMB.

The aircraft takes-off at 2,350 r.p.m. with the throttle fully open. At take-off run the aircraft is simple in handling, the tendency to turn to the right is easily compensated by the rudder deflection to the left.

The nose wheel clears the ground at a speed of 80km/hr., the aircraft - at a speed 115-120 km/hr.

Climb after maintaining a level flight speed of 140km/hr. At a maximum rate-of-climb (2,050 r.p.m.) the speed of climb from the sea level up to 2,000m is constant and equal to 140 km/hr. then reduces by 5 km/hr. for every 1,000 m.

From the altitude of 4,000m to 5,000m the speed of climb is constant and equal to 130 km/hr.

When climbing, the aircraft is simple to control and is trimmed by the elevator trim tab.

The stall, when the control stick is fully backward and the rudder is in the neutral position, is indicated by the aircraft shaking.

When the speed is reduced to minimum the aircraft does not go into a spin but lowers the nose and increases the speed.

The aircraft goes into a spin at a speed of 110km/hr when the control stick is fully backward and a rudder pedal is energetically pushed forward in the desired direction. The aircraft performs a steep and normal spin.

SECRET

SECRET

25X1

When spinning, hold the elevators deflected. To [redacted] from a spin, set the control stick in the neutral position and simultaneously push a pedal in the direction opposite to rotation (opposite to a spin). After the rotation ceased, set the rudder pedals in the neutral position and smoothly recover the aircraft from a dive.

25X1

GLIDING AND LANDING.

With the landing gear and flap in the "up" position, the aircraft glides steadily at a speed of 150 km/hr. When extending the L.G. the trimming does not change. When gliding for landing with the L.G. and flap "down", the aircraft easily repeats the approach, levelling out at a speed of 140 km-hr. with the throttle fully open and the propeller set in low pitch (2350 r.p.m.).

LEVEL FLIGHT.

In level flight the aircraft is stable and easily operated at any speed.

Maximum range is obtained at an altitude of 500 m., speed of 175 km.hr, 1400 r.p.m. and manifold pressure of 500 mm Hg.

Cruising rating at an altitude of 1,000 m.: speed of 190 km.hr., 1,730 r.p.m. and manifold pressure of 530 mmHg.

PIOTING.

When performing aerobatics, the aircraft is stable. At piloting, when moving the control stick excessively backward, the aircraft slightly shakes. The shaking stops, when moving the stick control forward and the aircraft has no tendency to go into a spin.

The aircraft performs evolutions: wing over loop and [illegible] maintaining constant altitude.

SECRET

25X1

SECRET

The speed, when perform[redacted] 25X1

[redacted]

Turn	180-200 km-hr.
Wing over	140-150 km.hr.
Loop	250 km.hr.
Half - loop	270 km.hr.
Combat turn	250 km.hr.
Rolling	220 km.hr.
Spiral	160-180 km.hr.
Max. operational overloading	5.8
Max. permissible IAS at diving	340 km.hr.

NIGHT FLYING.

To avoid the battery discharging, use the taxiing and landing lights provided they are fed from the generator, i.e. with the engine running at not less than 1,100-1,[illegible] r.p.m.

APPENDICES.

APPENDIX I.

VARNISH COATING REPAIR.

Varnish coating should be repaired at a temperature of 15-33°C and relative air humidity in a range of [illegible] and as a rule, indoors.

In calm and dry weather it is allowed to [illegible] aircraft in the open air.

It is prohibited to cool the aircraft with [illegible] to dry the lacker in the hot sun, at fog, [illegible] wind. Before varnishing, the aircraft should be [illegible] in care of the airfield, protected from [illegible] should be washed.

In bad weather (rain or fog) the aircraft should be [illegible] after 24 hours later after [illegible] dried.

SECRET

[redacted] 25X1

25X1

SECRET

When using a brush, the aircraft should be covered with a light and even coating of paint. The paint should be put on the surface in wide stripes, which are thoroughly shaded [redacted] he direction and then in the direction perpendicular to the first one. 25X1

When covering the aircraft with the final coating of paint, the latter should be shaded in the direction of flight.

When using a sprayer, the distance between the sprayer nozzle and the surface to be painted must be 250-350 mm; the air pressure - 2,5 - 4 atm.

The direction of the spray should be perpendicular to the surface.

When coating the aircraft with varnish, the spray is to be moved at a speed of 25-30 cm/sec, in two directions perpendicular to each other. The vertical surface should be sprayed by a horizontal spray of varnish or paint.

In case a viscosimeter is not available the paint viscosity can be determined by covering a metal plate surface with paint diluted in the way chosen for preparation of paint.

The plate coated with paint is placed at an angle of 45°.

If the paint does not spread on the plate the receiving substance is considered to have the required viscosity.

The following materials are used for varnish coating [illegible]

[illegible] (TU 2696-44) varnish for the first coating is a solution of varnish cellulose acetate in a mixture of [illegible] solvents and diluents; it is used for covering fabric skin. The varnish is put on the [illegible] in a brush.

The diluent (TU [illegible]) is a mixture of [illegible] hydrocarbons, ketones, ethers and alcohols of [illegible]

[illegible] is used as diluent of nitrocellulose and [illegible]

SECRET

25X1

SECRET

3. 9-32 (MXITY 32-58) colourless varnish is a solution of [redacted] resin in mixture of volatile organic solvents with [redacted] plastifiers added.

The varnish is used as an intermediate layer to cover fabric coverings coated with Nitrovarnishes.

The surfaces covered with 9-32 (MXITY 3219-58) varnish are then coated with perchlorvinyl enamels.

4. The semi-mat perchlorvinyl enamels XB3-4 (green), XB3-16 (grey-blue) and MXITY 2185-50 are dry perchlorvinyl resin solutions in organic solvents with some gliphtal resin and pigments mixed with plastifiers added to it. Metal and fabric skins are coated with the enamels by means of a sprayer.

5. The P-5 (MXITY 2194-50) diluter is a mixture of volatile organic solvents and is used to dilute perchlorvinyl varnishes, enamels, glue, putty and 9-32 varnish.

6. The MAK-4 (TOCT 5494-50) aluminium powder is fine grinded, polished aluminium with petal-type particles and is added to 9-32 varnish and XB3enamel.

FABRIC SKIN REPAIR IN CASE OF ITS LOOSENING AND CRACKS OF VARNISH COATING:

1. Remove old varnish coating from the surface to be repaired.

To do this, wash the surface with PDB diluter by means of a bristle brush and remove diluted coating from the surface with a dry cloth.

2. [redacted] washed surface with a cloth dampened in PDB diluter and then dry it for 15 min.

3. Put 9-32 varnish around the washed surface 3-5cm wide by means of a [redacted] and dry it for 1 hour.

4. Cover the [redacted] with four layers of [redacted] varnish by using a brush, the interval for drying [redacted] fourth layer for 4 hours. [redacted] varnish by sand paper [redacted] with clean dry cloth.

SECRET

SECRET

25X1

6. Cover the area to be repaired with 9-32 varnish [redacted] 2-3 cm of the main coating. 25X1

Add 2% of ПАК-4 aluminium powder to 9-32 varnish.

Dry the coating for 1-2 hours.

7. Put the first layer of ХВЭ enamel of a proper colour with the sprayer.

Add 2% of ПАК-4 powder into enamel.

Dry for 3-4 hours.

8. Clean the surface to be repaired with sand paper (grain 200), and remove dust with a brustle brush.

9. Put the second layer of ХВЭ enamel (without ПАК-4 powder) dry it for 24 hours.

FUEL AND LUBRICANT USED FOR AIRCRAFT.

1. B-70 gasoline (ГОСТ 1012-54)
2. МС-20 aviation oil (ГОСТ 1013-49)
3. МК-22 aviation oil (ГОСТ 1013-49)
4. ЦИАТИМ -201 lubricant (ГОСТ 6267-52)
5. МК-50 lubricant (ГОСТ 5573 -50)
6. 59 lubricant (ГОСТ 5699-51)
7. 56М lubricant (ГОСТ 4807-49)
8. Technical vaseline (ГОСТ 782-53)
9. "Л" turbine oil (ГОСТ 32-53)
10. Transformer oil (ГОСТ 982-56).

SECRET

25X1

SECRET

LABELS AND SIGNS ON THE SPECIAL EQUIPMENT UNITS INSTALLED [redacted] THE ЯК-18А AIRCRAFT

25X1

No.	Russian	English	Place
1	2	3	4
1	Скорость	Air speed	УС-350 air speed indicator-Instrument boards, front and rear cabins.
2.	Пох"ем	Up	АГИ-1 artificial horizon-Instrument boards, front and rear cabins.
	Спуск	Down	
	Нажать перед пуском	Press before start	
3	Пох"ем	Up	ВР-10 rate-of-climb indicator - Instrument boards, front and rear cabins.
	Спуск	Down	
	м/сек	m/sec.	
4	Высота	Altitude	ВД-10 altimeter-Instrument boards, front and rear cabins.
	км	km.	
5	Радиокомпас	Automatic direction finder	СУП-7 pilot's course indicator - Instrument boards, front and rear cabins.
6	Км/час	Km/h	ЭУП -53 electrical turn and bank indicator - Instrument boards, front and rear cabins.
7	Воздух сеть авар. кг/см²	Air Emergency system kg/cm²	Air pressure gauge - Instrument boards, front and rear cabins.
8	Нажать	Push	Voltammeter -Instrument boards, front and rear cabins.
9	Аэродромное питание откр., закр.	Ground supply open, close	Ground supply plug connection cover - Brackets, under the forth side opening [redacted]

25X1

1	2	3	4
10	007 [illegible]	R.P.M.	T3-45 tachometer indicator- Instrument boards, front and rear cabins.
11	[illegible]	North-South East-West	KM-12 compass - Canopy shroud, front and rear cabins.
12	ЛИТРЫ	Litres	Fuel contents gauge indicator - Instrument board, front cabin.
13	мм.рт.ст мм Hg.	мм Hg. Manifold pressure	MB-16 boost gauge - Instrument board, front cabin.
14	[illegible]	OFF ON	U.V.L. rheostat - Instrument boards, front and rear cabins.
15	[illegible]	Engine priming	Engine primer control - Starboard side control board, front cabin.
16	[illegible]	[illegible]; voice; [illegible] [illegible] [illegible]-tuning indicator volume tuning [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] Control(Remote- legal)	A.D.F. control panel - Starboard of the [illegible] and rear cabins.
17	[illegible]	[illegible]	Radio set control [illegible] Instrument board, [illegible] cabin.
[illegible]	[illegible]	[illegible]	[illegible] A.D.F. receiver [illegible] of the pilot's [illegible]

SECRET

1.Вращай ручку настройки против стрелки

1. Rotate the tuning crank of the control panel counter -clockwise to a stop.

2.Отсоедини гибкий вал от щитка и установи риску УПОР шкалы 640-1800 кгц по визиру.

2. Disconnect the tuning shaft from the control panel and set the "stop" mark on scale 640-1300 ko/s against the indicating mark.

3.Соедини гибкий вал со щитком и проверь совпадение риски УПОР с упором приемника и риской визира.

3. Conneot the tuning shaft to the control panel and check the alignement of the "stop" mark with the indicating mark and receiver stop position.

Примечание:После всякого раз"единения и соединения гибкого вала со щитком или приемником,установку шкал произвести вновь

NOTE: After every disconnection and connection of the tuning shaft from/to the control panel or receiver repeat the procedure above.

Усиление приемника:1.В положении АНТ ручку громкость установи на макс. и настройся на частоту вблизи 500кгц в точке, где нет мешающих станций.

Receiver gain:

1.With the function switch in the "ANT" (antenna) position set the volume control knob at maximum and tune to a frequency about 500ko/s at a point free of operating stations.

2.Отключи антенну от клеммы А приемника и отрегулируй [illegible], при. так чтобы шумы не были чрезмерно громки.

2.Disconnect the antenna from the "A" terminal of the receiver and adjust the "Rec.gain" so that the noise level should be not too high.

25X1

SECRET

1	2	3
[redacted]	[redacted]	[redacted]

25X1

[redacted]	3. Tune in distant stations, check excess sensitivity and if necessary, adjust the receiver gain.	
[redacted]	Loop cable length - 3 m.	
[redacted]	Loop	
[redacted]	Ground	
[redacted]	Lock	
[redacted]	Screen	
[redacted]	Antenna	
[redacted]	AVC response	
[redacted]	[redacted] gain	
[redacted]	[redacted] with	A.D.F. loop antenna - Fuselage turtle back
[redacted]	[redacted]	
[redacted]	[redacted]	
[redacted]	[redacted] loop	
[redacted]	[redacted] loop	
[redacted]	[redacted]	
[redacted]	[redacted]	
[redacted]	[redacted]	
[redacted]	[redacted]	"A" unit of the R-300 radio set. Radio set mount[ed] [redacted], aft of t[he] pilot's seat, re[ar] cabin.
[redacted]	[redacted]	
[redacted]	[redacted]	
[redacted]	[redacted]	
[redacted]	[redacted]	
[redacted]	[redacted]	
[redacted]	[redacted]	
[redacted]	[redacted]	
[redacted]	[redacted]	unit of the radio set - [redacted] mounting shelf, of the pilot's [redacted]

25X1

SECRET

CONTENTS

[redacted] 25X1

DESCRIPTION

GENRRAL.

OPERATING NOTES.

SECRET

[redacted] 25X1